

Sci. Bibl.

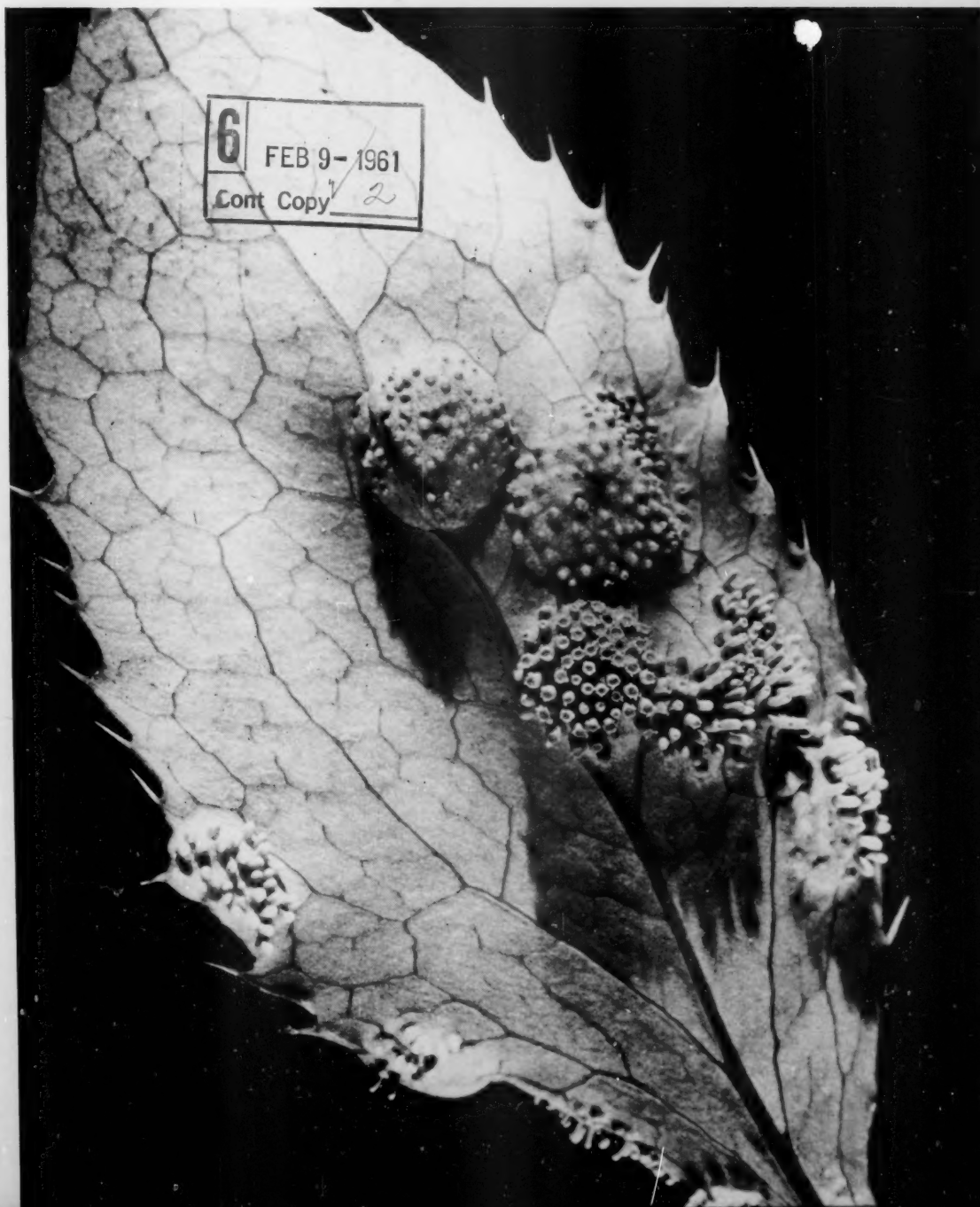
SCIENCE

10 February 1961

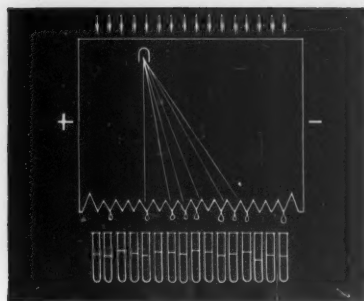
Vol. 133, No. 3450

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

2-27-61

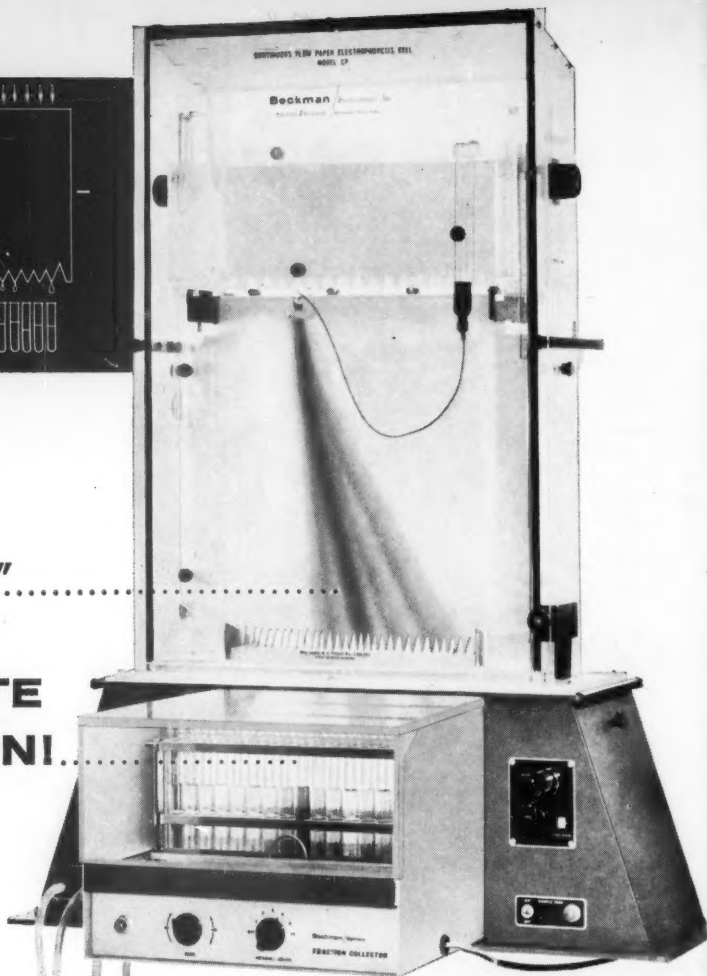


6 FEB 9-1961
Cont Copy 2



EACH "STREAM"..... IS A SEPARATE FRACTION!.....

Beckman/Spinco Model CP Continuous Flow Electrophoresis instrument with accessory fraction collector allows unattended runs of 72 hours.



As long as your biochemical or organic mixture is water-soluble and the fraction you want is ionized — chances are our Model CP Continuous Electrophoresis can separate it — and in quantity.

In the field for three years, the CP has solved a wide array of fractionating and purifying problems. In biochemistry the Spinco Model CP separates amino acids, peptides, hormones, sterols, bacteria, viruses, serum proteins and lipoproteins...is used in

processing antibiotics and concentrating vaccines.

In organic chemistry the CP can isolate the end product in many types of reactions, in quantities up to a gram of pure material a day. Often the various side products can be separated as well.

If you face the problem of preparing pure fractions in volume, investigate the CP Continuous Electrophoresis now. Fill in the coupon and you will receive literature by return mail.

TO: Spinco Division, Beckman Instruments, Inc.
Stanford Industrial Park, Palo Alto 5, Calif.

- ☐ Please send me applications bulletin 6055 giving typical operating conditions and literature references.
- ☐ Please send descriptive literature and prices on the CP.

NAME _____
TITLE OR DEPARTMENT _____
FIRM OR INSTITUTION _____
ADDRESS _____
CITY _____ STATE _____

Beckman / **Spinco Division**
Beckman Instruments, Inc.

New Science Textbooks

... from SAUNDERS

New! Orr —

VERTEBRATE BIOLOGY

A study of vertebrate animals of North America for students of zoology, science teachers in training, and students of conservation and wildlife. Fishes, amphibians, reptiles, birds and mammals are each considered separately—their organ systems, general and special characteristics, distribution and population dynamics. Clearly written discussions cover such topics as modern systematics—territorial concepts—physiological factors associated with dormancy, such as temperature, metabolism, circulatory system—sex recognition, courtship and pair formation.

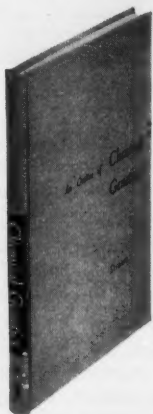
By ROBERT T. ORR, Ph.D., Curator of Birds and Mammals, California Academy of Sciences; Professor of Biology, University of San Francisco. About 450 pages, illustrated.
New—Ready April, 1961.

New! (2nd) Edition! Fischer —

QUANTITATIVE CHEMICAL ANALYSIS

Combines the features of a text and a lab manual in a single book. It covers all phases of quantitative analysis. The author discusses fundamental principles, gravimetric methods, volumetric methods, optical and electrical methods. New material has been included on analytical balance; precipitation processes; neutralization reactions; complexometric titration; theoretical treatment of oxidation-reduction reactions. New lab experiments have been added on optical and electrical methods. All line drawings of equipment are completely new.

By ROBERT B. FISCHER, Ph.D., Professor of Chemistry, Indiana University. About 425 pages, illustrated.
New (2nd) Edition—Ready April, 1961.



New! Strauss —

An Outline of CHEMICAL GENETICS

A concise presentation of chemical genetics, highlighting the latest developments in the role of nucleic acids—particularly DNA. Basic principles of genetics are fully covered in discussions on: protein synthesis, chemical nature of hereditary material, genetic recombination, mutations, nucleo-cytoplasmic relationships and biochemical genetics. DNA—its structure, synthesis and distribution to progeny, is fully explained. Inborn errors of metabolism, embryonic development, aging, infection and immunity and similar manifestations of how cells and biological changes affect one another are discussed.

By BERNARD S. STRAUSS, Ph.D., Associate Professor of Microbiology, The University of Chicago. 188 pages, illustrated. \$5.00.
New!

New! Carpenter —

MICROBIOLOGY

A general microbiology textbook for students taking a single course in this field. Equal attention is given to each of four phases of microbial life: 1) a general survey of microorganisms; 2) a detailed study of the biology of bacteria—their metabolism, growth, death and genetics; 3) the ecologic relationships and role of microorganisms in natural or controlled environments; 4) the interactions of pathogenic microorganisms with their plant or animal hosts. The style is concise and straightforward with a minimum of material to be memorized. Illustrations emphasize principles and general concepts. This complete text provides a good foundation for further study in medicine or in various specialties such as pathogenic bacteriology or sanitary, soil and industrial microbiology.

By PHILIP L. CARPENTER, Ph.D., Professor of Bacteriology, University of Rhode Island. About 480 pages, with 246 illustrations.
New—Ready April, 1961.

Consider these texts for your courses

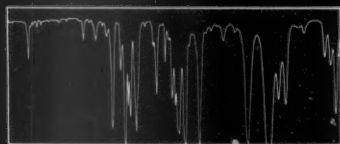
W. B. Saunders Company

West Washington Square

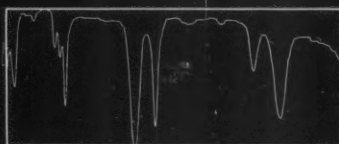
Philadelphia 5, Pa.

KEEP YOUR LAB AHEAD IN INFRARED WITH LOW-COST INFRACORD® SPECTROPHOTOMETERS

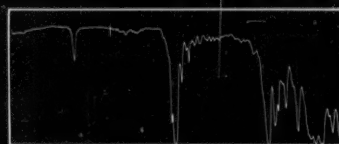
One of Perkin-Elmer's line of Model 137 Infracord® Spectrophotometers. Alike in appearance and operation, instruments differ in spectral regions covered as shown by chart paper. Sample is 1,2,4-Trichlorobenzene.



NaCl Model 137. Scans fundamental infrared range 2.5μ to 15μ —in 12 minutes; suitable for 70% of all analytical problems involving organic chemicals.



KBr Model 137. Scans from 12.5μ to 25μ in 6.5 minutes; provides data impossible or difficult to obtain at shorter wavelengths.



Model 137-G. Newest Infracord; this grating instrument covers the highly significant 8.3μ to 25.5μ region with high resolution. Two-speed wavelength drive permits either 24-minute scan for quantitative analysis or 8-minute scan for survey work.

INSTRUMENTS COVER THREE IR RANGES. Three Infracord Spectrophotometers are available. All are double-beam instruments, similar in appearance, accuracy, reliability, simplicity, low cost and availability of accessories for sampling and special analyses. They differ only in the IR spectral region covered and in their optics.

Any laboratory can improve its analytical efficiency with one or more low-cost Perkin-Elmer Model 137 Infracord® Spectrophotometers.

The cost—\$4500 for the NaCl Model 137—is one-half to one-third that of infrared instruments designed for more complex and demanding work. Despite this difference in price, P-E Infracords can handle most analytical problems a chemist in research and development, process or quality control, must perform. This means you don't pay for performance you don't need... nor for a high-salaried specialist, since a technician can operate the Infracord after a few minutes' instruction.

For laboratories with no IR instrument, an Infracord means cutting analytical time from hours to minutes... achieving accuracy and reliability unmatched by other techniques. Re-

sults are presented as standard spectra on notebook-size paper for easy reference and filing as a **permanent record**.

For large laboratories, the use of a number of Infracords provides rapid, accurate analysis of the more routine samples... prevents delays at the spectroscopy lab... keeps more sophisticated IR equipment and skilled spectroscopists busy at problems only they can handle.

For multi-laboratory organizations, an Infracord at each of a company's decentralized labs stems the flow of samples to the central research lab for IR analysis. It provides better analytical service in the field... leaves the central lab free for more basic work.

For complete information on all Infracords, write to the Perkin-Elmer Corporation, 910 Main Avenue, Norwalk, Conn.

Ask about our instrument leasing program.

INSTRUMENT DIVISION
Perkin-Elmer Corporation
NORWALK, CONNECTICUT

Editorial	Footnote to History	355
------------------	---------------------------	-----

Articles	Man-Guided Evolution in Plant Rusts: <i>T. Johnson</i>	357
	Through his modification of the host plants of the cereal rusts, man is also modifying the rusts.	

	Personality and Scholarship: <i>P. Heist et al.</i>	362
	The traits of able students at colleges productive of scholars are different from those of other able students.	

Science in the News	Kennedy's Economics: The Dismal Science Made Cheery; Science, Education, and Economic Growth	367
----------------------------	---	-----

Book Reviews	<i>McGraw-Hill Encyclopedia of Science and Technology</i> , reviewed by <i>D. Wolfle</i> ; other reviews	374
---------------------	---	-----

Reports	Intellectual Potential and Heredity: <i>G. Allen; H. Knobloch and B. Pasamanick</i>	378
----------------	---	-----

	Calcite in <i>Lesquerella ovalifolia</i> Trichomes: <i>F. C. Lanning</i>	380
--	--	-----

	Incorporation of Heterologous Deoxyribonucleic Acid into Mammalian Cells: <i>K. G. Bensch and D. W. King</i>	381
--	---	-----

	Time-out from Positive Reinforcement: <i>N. H. Azrin</i>	382
--	--	-----

	Effect of Psychotropic Drugs on the Uptake of H^3 -Norepinephrine by Tissues: <i>J. Axelrod, L. G. Whitby, G. Hertting</i>	383
--	---	-----

	Evaporative Water Loss of Small Vertebrates, as Measured with an Infrared Analyzer: <i>R. M. Chew and A. E. Dammann</i>	384
--	--	-----

	Electrocardiographic and Behavioral Effects of Emetine: <i>A. Marino</i>	385
--	--	-----

Departments	Letters from <i>D. Bodian and R. Thompson; P. Siekevitz; H. T. Stearns;</i> <i>R. P. McIntosh and D. B. O. Savile</i>	388
--------------------	--	-----

	Forthcoming Events	392
--	--------------------------	-----

Cover	Leaf of barberry, <i>Berberis vulgaris</i> , showing the aecial or cluster-cup stage of stem rust which is a factory for the production of new rust races of which only the best adapted gain wide distribution. See page 357. [W. E. Clark, Research Station, Canada Department of Agriculture, Winnipeg, Manitoba]	
--------------	---	--



Removes impurities automatically

FISHER ZONE REFINER

- Automatic Purification to PRIMARY STANDARDS
- Impurities Removed TOGETHER
- Any Number of Passes Are Cycled Automatically
- Compact—Only 10" x 15" of Bench Space
- Operates Anywhere on Standard 115-Volt A.C.
- Refines Most Reagents That Melt at 50° to 300° C
- For Upward, Downward or Horizontal Operation

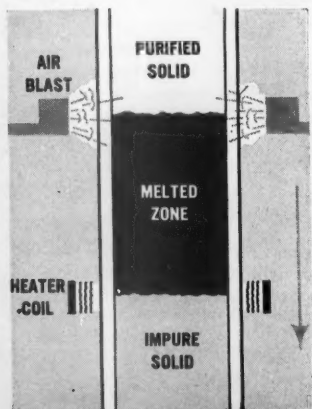
HOW MANY hours have you been wasting, purifying reagents by tedious, step-by-step refining methods? With the new Fisher Zone Refiner (patent applied for), you can now attain virtually any desired purity in your primary standards—*automatically*—for nearly any organic or inorganic chemical with a melting point between 50° and 300° C.

THE FISHER Zone Refiner utilizes the technique first developed by Bell Laboratories for purifying germanium for transistors—where purity standards are fantastically high. It utilizes the principle of repeated freezing, melting and refreezing . . . and can be set for a single pass, or as many as necessary or desired. You can set your *own* standards of purity—and achieve them.

IMPURITIES are removed together, and retained; where desired, they can be concentrated until there is an adequate sample for precise quantitative analysis. Or, of course, simply discarded. Purification of charges as small as one ml is thoroughly practical, and the full capacity of the device is 55 ml.

For full details, please write: Fisher Scientific Company, Box 139, Fisher Building, Pittsburgh 19, Pa.

F-94



LEFT: As each melted zone passes through the sample, the impure compound melts in front and purified material freezes out behind.



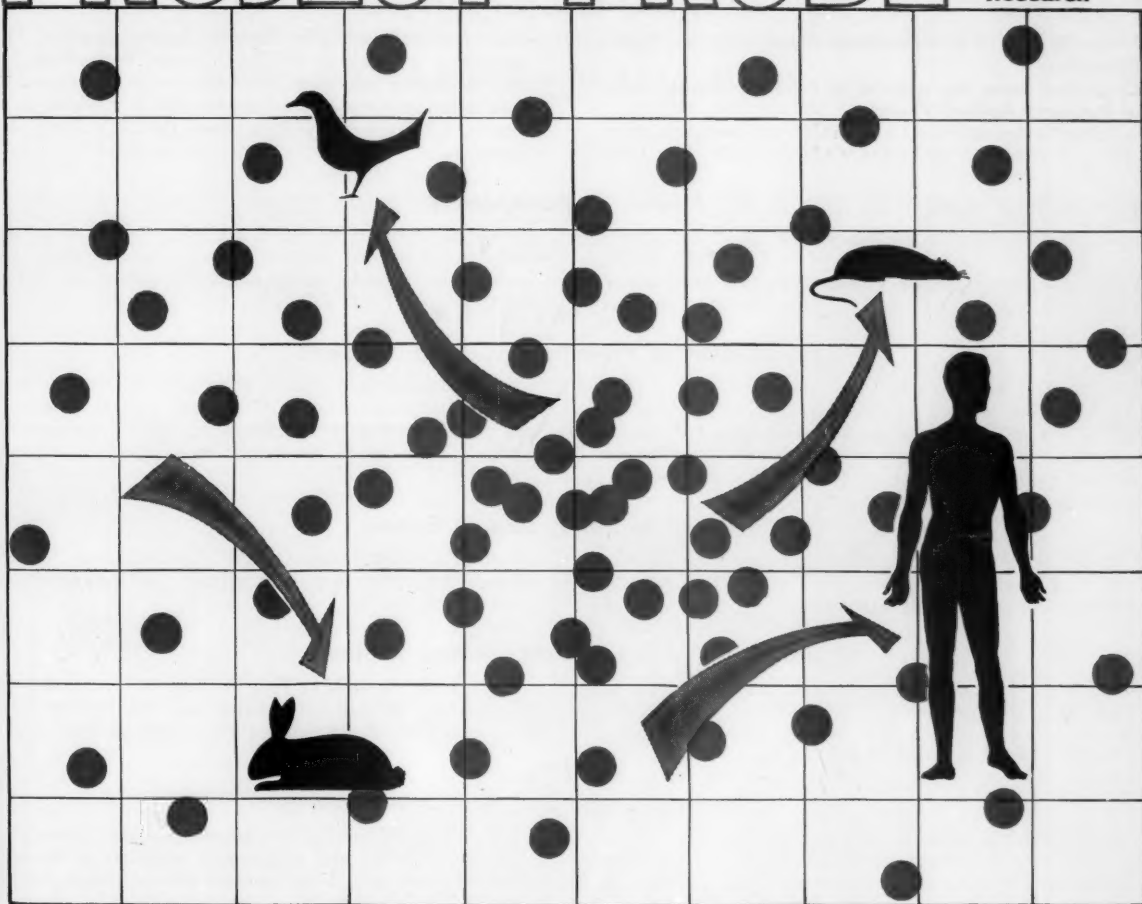
FISHER SCIENTIFIC

World's Largest Manufacturer-Distributor of Laboratory Appliances & Reagent Chemicals

Boston • Chicago • Fort Worth • Houston • New York • Odessa, Texas
Philadelphia • Pittsburgh • St. Louis • Washington • Montreal • Toronto

MELPAR LAUNCHES: PROJECT PROBE

*The Parade of
Disciplines in the
Most Advanced
Areas of
Bioscientific
Research*



Today, launching a diversity of bioscientific programs, Melpar is probing many new areas in depth and breadth in all of the life sciences. Under the leadership of Dr. Milton A. Mitz, these include such areas as:

Bio-organic Chemistry, the isolation and characterization of natural products.

Physiological Chemistry, the mode of action of drugs and the general problems of intermediate metabolism.

Biological Chemistry, electronic nature of nerve action.

Enzymology, the chemical structure, the kinetic mechanism, and the specific function of biological catalysts.

What is the nature of nerve action? What is the function of a biological catalyst? These represent but a few of the areas Melpar is now exploring. This is Melpar: Project Probe.

Scientists with advanced degrees in Biochemistry, who are interested in participating in **Melpar: Project Probe**, are invited to write to F. J. Drummond, Professional Placement Manager, 3348 Arlington Boulevard, Falls Church, Virginia.

MELPAR  **INC**
A Subsidiary of Westinghouse Air Brake Company



Viscoelastic Properties of Polymers

By JOHN D. FERRY, *University of Wisconsin*. In an exacting and uniform treatment of the viscoelastic properties and behavior of polymers, the author carefully develops a discussion of the phenomenological theory of visco-

elasticity, followed by the presentation of a wide variety of experimental methods and a critical appraisal of their applicability to polymeric materials of different characteristics. 1961. 482 pages. Prob. \$15.00.

International Education in Physics

Proceedings of the International Conference on Physics Education

Organized under the auspices of the International Union of Pure and Applied Physics

Edited by SANBORN C. BROWN, *Massachusetts Institute of Technology*; and NORMAN CLARKE, *The Insti-*

tute of Physics and The Physical Society, London. This conference was held at UNESCO House, Paris, from July 18th to August 4th, 1960. The book is the first attempt to look at the problem of physics education as a whole, in all aspects. (A Technology Press Book, M.I.T.) 1960. 208 pages. \$4.50.

Studies in Paleobotany

By HENRY N. ANDREWS, JR., *Washington University*. With a chapter on palynology by CHARLES J. FELLIX. The primary theme projected in this introductory book is the evolution of vascular plants from the time that

they first appeared on land, focussing on fossil groups that have a bearing on the origin of modern ones. The author also introduces occasional discussions of related living groups. 1961. 487 pages. \$11.75.*

Introduction to Parasitology, Tenth Edition

With Special Reference to the Parasites of Man

By the late ASA C. CHANDLER, and CLARK P. READ, *The Rice Institute*. In its consideration of special categories and in its general outlook, this is the most concise and modern treatment of medical entomology avail-

able. The latest information is reflected in the treatment of the classification, life histories, and general biology of the parasites—and those aspects of applied parasitology which are of special concern to man. 1961. 822 pages. Prob. \$9.75.

Physical Chemistry, Second Edition

By FARRINGTON DANIELS and ROBERT A. ALBERTY, *both of the University of Wisconsin*. Completely rewritten and substantially expanded, this new edition of

Physical Chemistry now covers more areas of modern physical chemistry than ever before. 1961. Approx. 776 pages. Prob. \$8.75.

Kinetics and Mechanism, Second Edition

A Study of Homogeneous Chemical Reactions

By ARTHUR A. FROST and RALPH G. PEARSON, *Northwestern University*. The authors have thoroughly revised their book in order to provide information which

is completely up-to-date. They continue to emphasize the complexities of chemical reaction and the close relation of kinetics to mechanism. 1961. Approx. 432 pages. \$11.00*.

Planets, Stars, and Galaxies

By STUART J. INGLIS, *Contra Costa College*. This is an introduction to astronomy for those who do not have a background in mathematics and science, and yet want to understand the physical universe. The book presents im-

portant ideas and theories that astronomers have formulated with regard to the age, origin, and evolution of the universe as a whole and the celestial objects therein. 1961. Approx. 480 pages \$6.75.

Fundamental Physics

By JAY OREAR, *Cornell University*. Dr. Orear emphasizes the understanding of basic principles and their relation to all of physical science. He recognizes the enormous progress that has taken place in the last few decades in

man's understanding of physical reality. Many applications of the basic principles are presented, including earth satellites, radio, TV, chemistry, astronomy, nuclear weapons, etc. 1961. 381 pages. \$6.75.

The Chemistry of the Terpenes

By A. R. PINDER, *University of Wales*. Contains the essentials of terpene chemistry and gives special regard to the reactions involved in degradation and synthesis, the interesting chemical transformations encountered in the

field, and some of the more recent developments concerning stereochemistry and biosynthesis. 1961. 233 pages. \$8.00.

* Textbook edition also available for college adoption.

JOHN WILEY & SONS, Inc.

440 Park Avenue South, New York 16, N.Y.

Preparative gas chromatography points to new standards of purity. The Megachrom's* large sample capacity, 100 times larger than that of typical analytical instruments, is a potent new tool for the research chemist. Chromatographic resolution of large volume samples, up to 20 cc, quickly and conveniently isolates workable quantities of fractions that are 99.99+ % pure—so pure that they re-define established infrared standards. Infrared spectra of ultra-pure trace components now can serve to identify low ppm concentrations of flavor- and odor-causing contaminants, and trace impurities resolved from raw material inputs or finished products. The Megachrom is a convenient means of separating and purifying the components of basic process streams for reaction studies aimed at improving process efficiency and controlling undesirable side reactions. For complete information, write us for Data File 38-6-04

Beckman

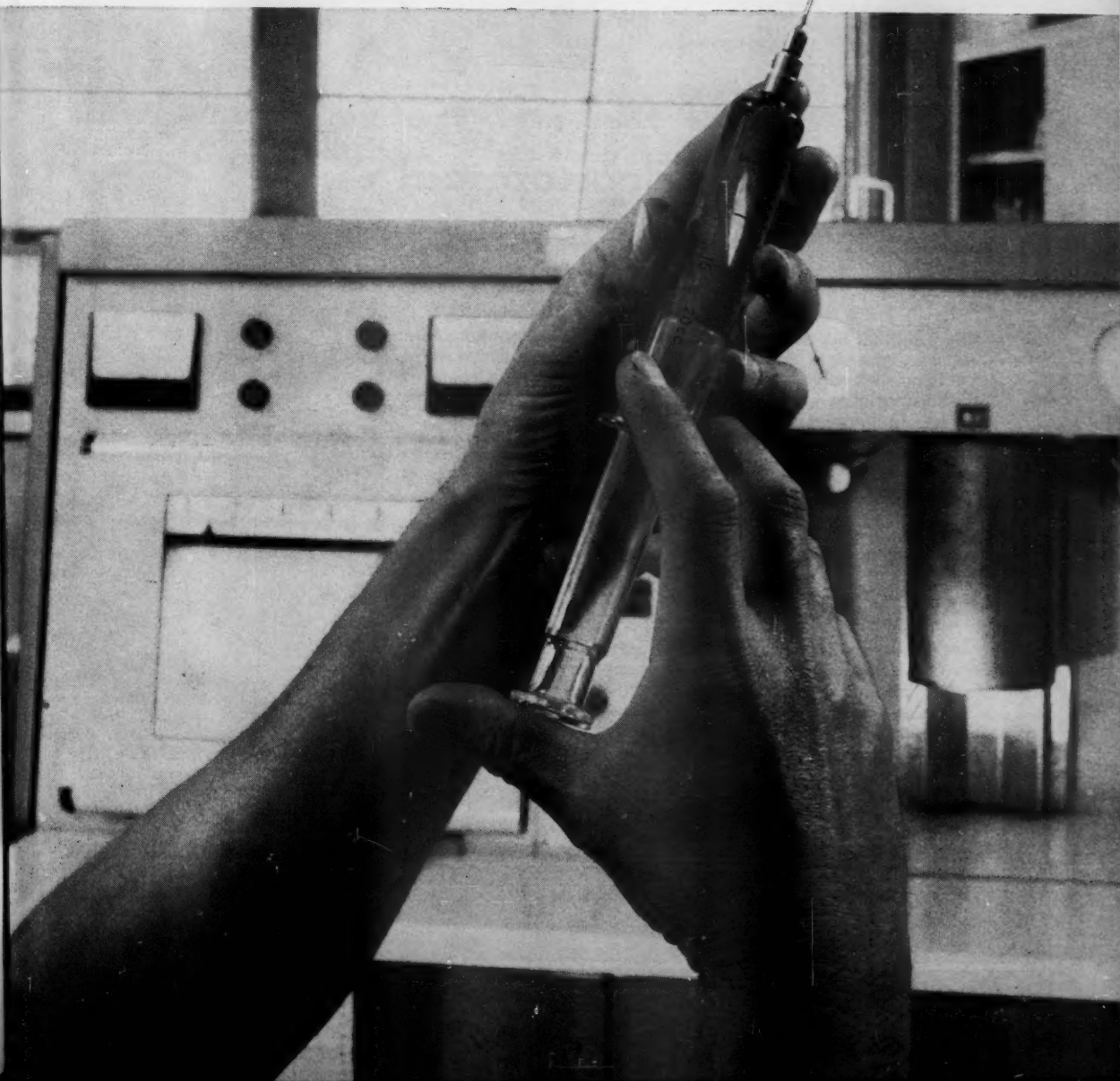
Scientific and Process

Instruments Division

Beckman Instruments, Inc.

Fullerton, California

*TRADEMARK, BII



COLEMAN



Program for Economical Laboratory Growth

Good laboratory planning provides for the orderly growth and expansion of laboratory facilities.

Planning that begins with a Coleman Junior Spectrophotometer assures immediate mastery over the great science of spectrophotometric analysis—but more important it sets the stage for the addition of new techniques and whole new analytical sciences:

The Coleman Ultramicro Analytical Program adds the whole new science of ultramicro analysis to the Junior Spectrophotometer, without interruption of existing routines or addition of unnecessary new equipment;

The Coleman Flame Photometer combines with the Junior Spectrophotometer, in a masterpiece of efficiency and economy, to add rapid, precise flame measurements of Na, K, Ca, Mg;

The Coleman Electronic Photofluorometer is the finest and most economical instrument for general fluorimetric analysis. Operated with the Junior Spectrophotometer it achieves a fifteen-fold gain in sensitivity that gives it analytical capabilities surpassing those of instruments costing more than twice as much.

This is planned instrumentation, providing orderly, economical expansion of laboratory scope, without obsolescence or disturbance of the foundations upon which the growth is built.



Coleman Flame Photometer



Coleman Electronic Photofluorometer

Coleman Ultramicro Analytical Program
Coleman Electronic Photofluorometer
Coleman Flame Photometer

Bulletin No. SB-263
Bulletin No. SB-245
Bulletin No. SB-242A

COLEMAN INSTRUMENTS, INC., MAYWOOD, ILLINOIS

AMERICAN ASSOCIATION
FOR THE
ADVANCEMENT OF SCIENCE

Board of Directors

CHAUNCEY D. LEAKE, *Retiring President, Chairman*
THOMAS PARK, *President*
PAUL M. GROSS, *President Elect*
HARRISON BROWN DON K. PRICE
HENRY EYRING ALFRED S. ROMER
H. BENTLEY GLASS WILLIAM W. RUBEY
MARGARET MEAD ALAN T. WATERMAN
PAUL A. SCHERER, *Treasurer*
DAEL WOLFLE, *Executive Officer*

Editorial Board

KONRAD B. KRAUSKOPF H. BURR STEINBACH
EDWIN M. LERNER WILLIAM L. STRAUS, JR.
PHILIP M. MORSE EDWARD L. TATUM

Editorial Staff

DAEL WOLFLE HANS NUSSBAUM
Publisher Business Manager

GRAHAM DUSHANE
Editor

JOSEPH TURNER ROBERT V. ORMES
Associate Editor Managing Editor

ELLEN E. MURPHY, *Assistant Editor*

NANCY TEIMOURIAN, *Assistant to the Editor*

News: HOWARD MARGOLIS, BETHSABE ASENJO

Book Reviews: SARAH S. DEES

Editorial Assistants: NANCY S. HAMILTON, EDGAR C. RICH, BARBARA SUTHERLAND, CONRAD YUNG-KWAI

Staff Assistants: PATRICIA D. PADDOCK, LOIS W. WOODWORTH

Advertising Staff

EARL J. SCHERAGO, *Director*

BERNICE SCHWARTZ, *Production Manager*

Sales: RICHARD L. CHARLES (New York, N.Y., PE 6-1858); C. RICHARD CALLIS (Old Bridge, N.J., CL 4-3680); HERBERT BURKLUND (Chicago, Ill., DE 7-4973); DILLENBECK-GALLAVAN (Los Angeles, Calif., DU 5-3991)

SCIENCE, now combined with THE SCIENTIFIC MONTHLY, is published each Friday by the American Association for the Advancement of Science at National Publishing Company, Washington, D.C. SCIENCE is indexed in the *Reader's Guide to Periodical Literature*.

Editorial correspondence should be addressed to SCIENCE, 1515 Massachusetts Ave., NW, Washington 5, D.C. Manuscripts should be typed with double spacing and submitted in duplicate. The AAAS assumes no responsibility for the safety of manuscripts or for the opinions expressed by contributors. For detailed suggestions on the preparation of manuscripts, see *Science* 125, 16 (4 Jan. 1957).

Advertising correspondence should be addressed to SCIENCE, Room 740, 11 West 42 St., New York 36, N.Y.

Change of address notification should be sent to 1515 Massachusetts Ave., NW, Washington 5, D.C., 4 weeks in advance. If possible, furnish an address label from a recent issue. Give both old and new addresses, including zone numbers, if any.

Annual subscriptions: \$8.50; foreign postage, \$1.50; Canadian postage, 75¢. Single copies, 35¢. Cable address: Advancsci, Washington.

Copyright 1961 by the American Association for the Advancement of Science.

Footnote to History

In his farewell address to the nation on 17 January 1961 President Eisenhower had this to say about science and technology:

"Today, the solitary inventor, tinkering in his shop, has been overshadowed by task forces of scientists in laboratories and testing fields. In the same fashion, the free university, historically the fountainhead of free ideas and scientific discovery, has experienced a revolution in the conduct of research. Partly because of the huge costs involved, a government contract becomes virtually a substitute for intellectual curiosity. For every old blackboard there are now hundreds of electronic computers.

"The prospect of domination of the nation's scholars by federal employment, project allocations, and the power of money is ever present—and is gravely to be regarded.

"Yet, in holding scientific research and discovery in respect, as we should, we must also be alert to the equal and opposite danger that public policy could itself become the captive of a scientific-technological elite."

A good many scientists have shared this concern about the "equal and opposite danger" and would welcome further discussion. G. B. Kistiakowsky, President Eisenhower's Special Assistant for Science and Technology, writes in this connection:

"I would like to comment briefly about President Eisenhower's reference to science and technology in his farewell address. Several questions have been directed to me about it, and since Mr. Eisenhower talked to me at some length later that week, others may be interested to know more about his views than could be developed in a short talk.

"The major point, I believe, which he wanted to convey was his conviction that the part of science which is engaged in for armaments purposes must never be allowed to dominate all of science or curtail basic research. He was concerned to see so many pages of advertisements identifying 'science' with armaments, asserting to the people that research means just bigger and better missiles, etc., while very little is said about the true nature of basic research as a cultural endeavor and a source of advancing welfare to the people. And he was particularly anxious that educational institutions, whose task he sees as the support of free intellectual inquiry and the acquisition of new scientific knowledge, should not concentrate on large-scale military research and development contracts at the expense of their true scientific endeavors.

"In line with these ideas, I believe President Eisenhower was concerned that the emphasis on military research and development in our industry, press, and even institutions of higher learning could create a combination of special interests highly undesirable in our society. His reference in the speech to the scientific-technological elite I know was meant in this context.

"It is interesting to me to realize how similar the views of Mr. Eisenhower are in these matters to those I have heard many times from scientists all over the nation, and which I share. I think, in part, this reflects the great interest in and support for science President Eisenhower demonstrated during his term of office."—G.DuS.



See it anywhere between 3.5X and 120X

With Bausch & Lomb StereoZoom® Microscopes, just turning a knob gives you an infinite number of repeatable magnifications within the range selected. Powers available from 3.5X to 120X.

And, a new "Power Pod" optical design completely encloses the optical system in a single unit—keeps out dust and dirt, eliminates annoying image jump and blackout.

Why not see today's most versatile microscope soon in a free laboratory demonstration.

*Made in America,
to the world's highest standard*

BAUSCH & LOMB INCORPORATED
64214 Bausch St., Rochester 2, N. Y.

- ☐ Please arrange a free laboratory demonstration at my convenience.
- ☐ Please send Catalog D-15 with complete information on B&L StereoZoom Microscopes.

Name

Address

City Zone State

BAUSCH & LOMB

SINCE  1853

See the World's Greatest Display of Gratings and Grating Instruments. Visit B&L Booths, 9, 20, 21 at the Pittsburgh Conference on Analytical Chemistry and Applied Spectroscopy, Hotel Penn-Sheraton, Feb. 27-March 3.

CURRENT PROBLEMS IN RESEARCH

Man-Guided Evolution in Plant Rusts

Through his modification of the host plants of the cereal rusts, man is also modifying the rusts.

T. Johnson

It is a commonplace that man's interference with nature results in modification of plants and animals. This is so well known that the subject scarcely merits discussion unless facts emerge that throw some light on the mechanism of the process of modification. The rusts of wheat and other cereals (and particularly stem rust, *Puccinia graminis*) are among the most important enemies of man's food crops. Within the last 40 years plant breeders have modified the wheat plant in such a way that, in certain of the more important wheat-growing areas, the modifications have greatly influenced the pathogenic properties of the rust parasites. The pathogenic response of the rusts to these changes are such that they can be causally related to the man-made modification of their hosts. This relationship would seem to be of sufficient biological interest to be worth reporting beyond the relatively small circle of specialists who have been directly concerned with these phenomena (1).

Cereal Rusts Prior to the

Breeding of Resistant Varieties

As stem rust is economically the most important of the cereal rusts, and the one on which investigation has been concentrated, I will use it as the

principal basis of discussion. It may be assumed that processes of variation applicable to this rust are also applicable to most other rusts.

The host species most frequently subjected to modification by breeding and selection is the 42-chromosome wheat, *Triticum aestivum* (= *Triticum vulgare*), which comprises the world's principal bread-making varieties. Before breeding for rust resistance was begun, the varieties of bread wheat grown by farmers in the various wheat-growing countries were susceptible to stem rust (Fig. 1). The earliest studies on the pathogenicity of stem rust, carried out in Sweden in the last decade of the 19th century by Jakob Eriksson (2), showed that the rust was not a single unit, pathogenically. Rust collected on wheat was pathogenic to wheat, barley, and certain grasses but attacked rye only slightly and oats scarcely at all. Rust collected on rye was pathogenic to rye, barley, and certain species of grass but not to wheat or oats. Rust collected on oats attacked oats and certain grasses related to that crop but was nonpathogenic to the other cereals. In general, it was clear that the rust was parasitically adapted to the host plant on which it was found. As the morphological differences between the rust samples collected on these plant hosts were so small as to be insignificant, Eriksson regarded these pathogenic var-

iants as *formae speciales* of the rust species *Puccinia graminis*.

Stakman and his co-workers (3) showed that this pathogenic specialization was more narrowly restricted than had been suspected by Eriksson. They found that rust collected on given varieties of wheat was parasitically adapted to those varieties but not necessarily to other varieties. In consequence it was possible, by judicious selection of wheat varieties, to develop a series of "differential hosts" whereby numerous pathogenically distinct "physiologic races" of wheat-stem rust could be identified by means of the infection types produced on wheat plants in the seedling stage. Stakman and his collaborators showed, furthermore, that these physiologic races would remain constant in their pathogenic behavior over a period of many years and could therefore be regarded as relatively stable biological entities (4).

Breeding of Rust-Resistant

Bread-Wheat Varieties

The discovery of physiologic specialization in wheat-stem rust had far-reaching practical implications. It was demonstrated that a given variety of wheat (such as Marquis) might be resistant to a large group of physiologic races but susceptible to another group. Another variety (such as Kanred) might be resistant to many of the races that could attack the first variety, though susceptible to other races. Both varieties would be susceptible in the field because of the multiplicity of rust races occurring in nature. The range of resistance could, however, be broadened by crossing the two varieties. Some of the plants descended from a cross would have resistance to more races than either parent. These plants could, in turn, be crossed with other varieties so as to broaden the range of resistance still further. Theoretically, it should have been possible, by a long

The author is director of the Canada Department of Agriculture Research Station, Winnipeg, Manitoba.

series of such crosses, to produce a variety resistant to all or most of the races. But, as new races were found every year, it was found to be impracticable to produce totally rust-resistant varieties by this method.

In effect, the problem of producing rust-resistant varieties of bread wheat was solved by other means. In some of the major rust epidemics in the United States and Canada, from 1904 onward, it was observed that certain varieties of wheat were free from rust. These, however, were not bread wheats. They were either durum wheats (*Triticum durum*) or emmer wheats (*T. dicoccum*). The fact that both these species had 28 chromosomes instead of the 42 chromosomes of bread wheat cast doubt on the possibility of crossing these wheats with the bread wheats. Efforts were made by many plant breeders in North America, and these efforts eventually bore fruit in the production of a hybrid between the durum variety Iumillo and the bread wheat Marquis (5) and the production of a hybrid between the emmer variety Yaroslav and Marquis (6). In each case the hybrids had the appearance of bread wheats but had much of the rust resistance of the durum or emmer parent. These hybrids were later used in crosses with

high-quality bread wheats, with the result that many rust-resistant spring wheats of good quality for breadmaking were distributed to farmers between 1935 and 1940 in the "rust area" of the Dakotas, Minnesota, and the Canadian Prairie Provinces. In the region subject to greatest rust damage these varieties totally replaced the older, susceptible varieties.

General Characteristics of Rust-Resistant Varieties

In the first decade of this century Sir Rowland Biffen (7) showed that resistance of wheat to yellow rust (*Puccinia glumarum*) was inherited in accordance with Mendelian laws. Resistance was recessive to susceptibility and was inherited as a simple Mendelian recessive. This was a discovery of significance for rust research because it showed that resistance to rust could be separated from other plant characteristics and recombined with other desirable qualities. Biffen's classical work inaugurated the era of scientific plant breeding for resistance to the rusts.

H. K. Hayes and his students demonstrated that, in crosses between varieties of bread wheat, a single rust-resistance gene (as, for instance, the Kanred gene) might condition resistance to a large group of rust races. The introduction into bread-wheat varieties of resistance from durum and emmer wheats, however, showed greater practical promise because durum and emmer resistance genes conferred a much broader range of resistance. The demonstration (8) that stem-rust resistance derived from emmer wheat and governed by one or two genes gave protection against all the known North American races appeared for a while to nullify the practical importance of physiologic specialization. This type of broadly based resistance was effective only in the adult stage and hence was known as "mature-plant" resistance. Plants which were susceptible to some races in the seedling stage were resistant to all known races in the adult stage, and the mature-plant resistance was inherited quite independently of any seedling resistance these plants might possess. When varieties with mature-plant resistance were distributed to farmers in the late 1930's, many plant breeders were hopeful that the physiologic races of stem rust had been effectually checked.

Genetical Characteristics of the Rust

Craigie's discovery (9) of the function of the pycnia of the rusts elucidated the sexual mechanism of the rusts and made possible the hybridization of physiologic races (10) (Figs. 2, 3). It was demonstrated that new races were readily produced by hybridization, and that races found in nature were generally heterozygous for various characteristics. Further studies showed that some, at least, of the pathogenic characteristics were inherited in accordance with Mendelian rules of inheritance (11).

Flor's classical studies (12) with flax rust (*Melampsora lini*) made it clear that there was a relationship between the genes for pathogenicity in a rust and the genes for resistance in the host plant. If a host plant had a given gene for resistance, it could be rusted only by a race that had a corresponding gene for pathogenicity; but if a host had two genes for resistance, it could only be rusted by a race (or races) with the two corresponding genes for pathogenicity. This gene-for-gene relationship is plausible in view of the fact that races can only be identified by the rust-reactions of the host, which have been shown to be gene-conditioned whenever they have been studied genetically, and the further fact that resistance genes can be demonstrated in the host only by the use of appropriate rust races. Thus, the host-parasite interaction has a genetic basis in both the host and the rust.

In most races of flax rust, virulence (ability to rust heavily) is a recessive character. Therefore, a race heterozygous for pathogenicity to a given host is avirulent on that host. In heterozygous rust clones a mutation of the dominant gene to the recessive confers virulence on the race (13).

Thus far, Flor's studies have given the principal clue to the interrelation of host and parasite. Host varieties differ greatly in their physiological processes, which are conditioned by genes. Some of these gene-conditioned processes are incompatible with the growth of a particular rust on the host. Rust races also differ in their physiological processes, which likewise are gene-conditioned. Compatibility of the gene-conditioned physiology of the host with the gene-conditioned physiology of the rust leads to susceptibility—hence the physiological interlocking of the genes of host and parasite.



Fig. 1. A susceptible variety of wheat infected by stem rust in the uredial or summer stage.

Respo
Grow

As
rust-re
taken
which
The
stem
the sp
States
(iii) K
these
ment
ties of
Ameri
to abo
The
was so
After
rust, a
type b
These
until s
been 1

Fig. 2 (C
of rust
only the

10 FEBR

Response of the Rust to the Growing of Resistant Varieties

As was natural, the lead in producing rust-resistant varieties of wheat was taken in those wheat-growing areas in which stem rust was a particular threat. The areas in which varieties resistant to stem rust were first distributed were (i) the spring-wheat region of the United States and Canada, (ii) Australia, and (iii) Kenya Colony in East Africa. In these areas there was a sudden displacement of susceptible by resistant varieties of wheat. In the rust area of North America the acreage involved amounted to about 20 million acres.

The response on the part of the rust was somewhat similar in all these areas. After an initial period of freedom from rust, a few infections of a susceptible type began to appear here and there. These increased in number year by year until some varieties of wheat that had been resistant had to be regarded as

susceptible. The rate of increase of rust development differed considerably in the different regions. In Australia, the variety Eureka, distributed in 1938, began to rust in 1941 and rusted considerably in 1942, after which date it was gradually replaced by other varieties. In North America, freedom from stem rust lasted from the period of distribution of the resistant varieties (1935-38) until 1950, when race 15B, first found in 1939, became relatively abundant in the Mississippi Valley. Thereafter, the increase of this race was rapid, culminating in the great stem-rust epidemic of 1954. In Kenya, a sequence of resistant varieties brought to light a sequence of rust races capable of attacking them.

The timing of the appearance of virulent races differed considerably in the different regions, as did also the pathogenic characteristics of the virulent races. These new races did not necessarily have a greater over-all virulence

than the older races; their virulence was specially adjusted to the new resistant varieties.

Mechanism of Interaction of Rust and Host

Changes of pathogenicity in the rust appear to proceed stepwise with reference to the host genes for resistance. A new type of stem rust capable of attacking a formerly resistant variety is most commonly a variant of some common race, the variant being identifiable only by its ability to attack (render ineffective) the gene that made the variety resistant to the original race. To remain resistant for long a variety needs to have more than one resistance gene operating against the races prevalent in the region of its cultivation. Figure 4, adapted from one employed by Australian investigators (14), illustrates the stepwise process by means of which a



Fig. 2 (left). The sweet exudate of stem rust in the pycnial stage attracts insects, which are important agents in natural hybridization of rust races. Fig. 3 (right). Stem rust in the acial or cluster-cup stage is a factory for the production of new races, of which only the best-adapted gain wide distribution.

race may overcome the resistance of a variety.

Two loci determining pathogenicity are assumed to be present in the rust race, and two loci determining resistance are assumed to be present in a wheat variety. The rust genes are not initially capable of affecting the resistance genes in the wheat. A mutation of rust gene *a* to *a'* will overcome the resistance effect of gene *A* in the variety, but the variety remains resistant because of the protective effect of gene *B*. For a similar reason mutation of *b* to *b'* does not affect the reaction of the variety. Mutation at both loci in the rust will affect both loci in the wheat and render the variety susceptible.

The type of thinking outlined above has considerably influenced the planning of wheat breeding programs. There are several possible procedures, all of which, of course, depend on the identification and isolation of genes for rust resistance. When a number of rust-resistance genes have been identified and segregated, they can be used in several different ways. They can be combined in pairs, as was done by the Australian breeders (14) (genes *AB* in one variety, *CD* in another, and so on), on the assumption that it is unlikely that rust races would simultaneously overcome several different types of resistance. Another procedure is the development of a multilinear variety in which various lines of the same morphological type contain different genes for resistance (15). In such a variety those lines that succumb to rust could be withdrawn and replaced by new lines as these become available. A third approach is the "pyramiding" of all available genes in the same variety in order to confer on that variety a maximum range of resistance.

Each of these processes is likely to produce its specific effect on the rust organism, and none is entirely free from objectionable features. The introduction of pairs of resistance genes is likely to give rise eventually to races with pathogenicity genes nullifying the resistance effect of the paired genes. The multilinear variety is likely to bring into being simultaneously a considerable variety of rust races and thereby increase the diversity of the gene pool of the rust. The variety containing all available resistance genes would become susceptible only to a race with a very wide range of pathogenicity, but the danger of encouraging the production of such a "super" race is obvious.

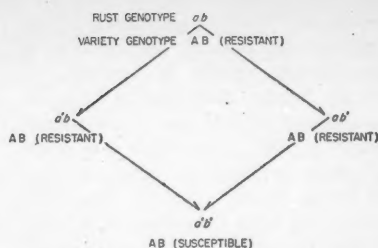


Fig. 4. Given two factors for resistance in the host, two corresponding mutations in the rust are necessary before the host becomes susceptible (see text).

No matter which plant-breeding procedure is adopted, it is clear that it will have a guiding influence on the pathogenic types of rust that eventually will appear in areas of large-scale cultivation of rust-resistant cereals. By his manipulation of rust-resistance genes the plant breeder is therefore guiding the evolution of pathogenic types in the rusts. Consequently, it is necessary to understand, as far as possible, the mechanism of the origin of new pathogenic types in the rusts and to correlate plant-breeding practices with that understanding.

Mechanism of the Origin of New Pathogenic Rust Types

Some acquaintance with the life cycle of stem rust is necessary to gain any understanding of how new pathogenic types originate. Stem rust is a heteroecious rust, spending part of its life cycle on cereals and grasses and part on certain species of barberry, of which the most important is common barberry, *Berberis vulgaris*. The repeating, uredial stage on cereals and grasses is followed, in autumn, by the telial stage. The spores of the telial stage survive the winter, germinate, and produce on the barberry the pycnial and aecial stages, which represent the sexual phase of the life cycle. The aeciospores re-initiate the repeating uredial stage on cereals and grasses.

Cytologically, the uredial stage is dikaryotic, each spore containing two haploid nuclei. Fusion to form a diploid nucleus occurs in the telial stage, in the maturing teliospore. In the germination of the teliospore two divisions occur, one reductional and one purely mitotic, resulting in the production of four basidiospores, two of (+) and two of (-) mating type. As each basidiospore can

give rise to a pycnium, the mating types of the pycniospores correspond with those of the basidiospores. For the production of aeciospores it is necessary to apply pycniospores of a (+) pycnium to a (-) pycnium, or vice versa. An aeciospore, therefore, contains a (+) and a (-) nucleus, and this dikaryotic condition is perpetuated in the uredial stage.

"Crosses" between races can be made readily by applying pycniospores of a (+) pycnium of one race to a (-) pycnium of another, or vice versa. The "selfing" of such a "dikaryotic hybrid" will produce many races displaying various combinations of the pathogenic characteristics of the races entering into the cross. The understanding of the sexual mechanism of the rust and its importance in the production of physiologic races was an important spur to the destruction of barberries in North America, of which some 500 million plants have already been eradicated.

It would be expected that the reduction in number of barberries in the Mississippi Valley area resulting from the active barberry eradication campaign carried out from 1918 onward would greatly minimize the creation of new races of rust by means of the sexual process. Nevertheless, new races were encountered frequently, and investigators began to suspect that other processes of variation must be at work in the creation of new pathogenic types of rust. Two such processes are known: mutation and heterokaryosis.

Many mutations, both spontaneous and artificially produced, have been recorded in the rusts (Fig. 5), and it is generally agreed that this fundamental source of variation is of great significance. Virulence is often a recessive character, and mutant genes undoubtedly accumulate in the uredial stage of the rust, to find expression after they have passed through the sexual phase on the barberry.

In recent years there has been considerable research effort to determine the possible significance of heterokaryosis in the origination of pathogenic types. Heterokaryosis per se, involving only the reassociation of haploid nuclei in uredial clones in contact with one another, is a less effective means of variation than hybridization. Two rust clones with nuclei *A'B'* and *C'D'*, respectively, can be expected to produce only the two recombinants *A'D'* and *B'C'*. Several studies on heterokaryosis (16, 17) have indicated a situation con-

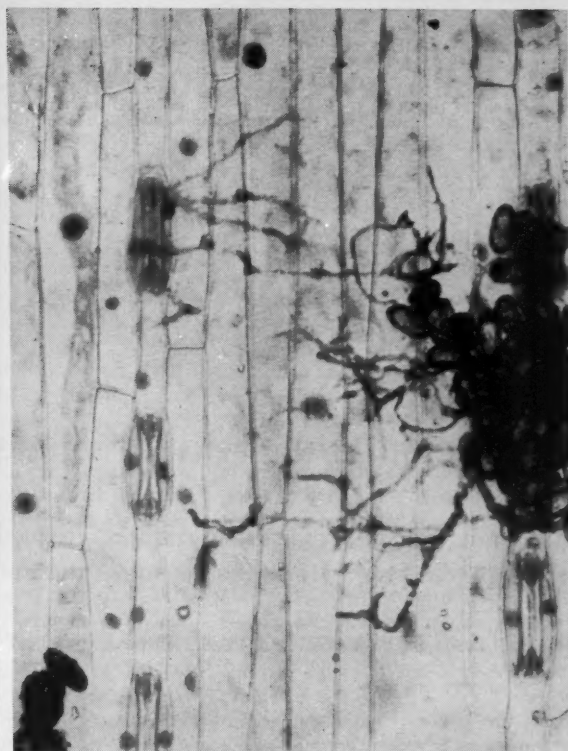
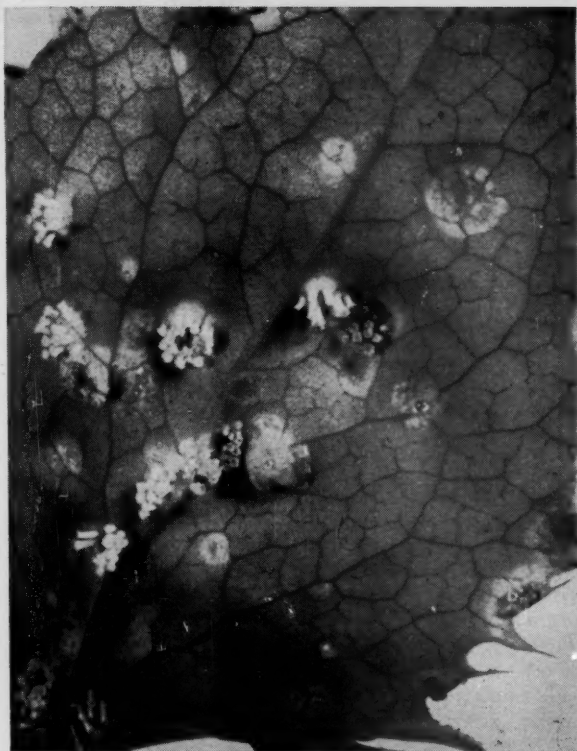


Fig. 5 (left). Mutation is a factor of importance in variation. In this photograph the white (mutant) aecia stand out in sharp contrast to the less conspicuous normal, yellow aecia. Fig. 6 (right). Germ tubes of uredospores often come into contact on leaf surfaces, or the mycelia which they produce after penetration may come into contact, thereby permitting nuclear exchange between different clones of the rust.

siderably more complex than that (Fig. 6). The large number of new pathogenic rearrangements secured from a combination of two clones suggests that some parasexual process must be at work. For this process Watson and Luig (17) have used the term *somatic hybridization*. Whether or not this process conforms to the parasexual processes outlined by Pontecorvo (18) is not yet known.

Although all the processes mentioned doubtless contribute to the production of new pathogenic types of rust, there is no good reason for assuming that hitherto unknown pathogenic types have come into being just before they were found. Nature must contain a large reservoir of pathogenic types that have not been detected by the physiologic-race surveys and other means of detection employed by the rust investigator. In addition, even the physiologic races already known must contain a pool of unexpressed genes for pathogenicity that may at any time come to light through sexual, heterokaryotic, or para-

sexual processes. The rust investigator and the plant breeder must therefore expect a continuing supply of previously unknown pathogenic types of rust.

The realization that there is a relationship between the genic constitution of the resistant host plant and the genic constitution of the rust race that may eventually attack it is of more significance for the plant-breeding methods of the future than for those of the past. For the last two or three decades plant breeders have been able to identify rust-resistance genes and separate them one from another. Initially the genes were identified and numbered without knowledge of the specific chromosomes on which they were located. More recently, through the brilliant work of Sears (19) and his collaborators, methods have been developed to determine on which chromosomes the genes are located. This knowledge, which is acquired by the use of nullisomic and monosomic lines, and the increasing use of backcrossing methods, make cereal breeding today much more precise than it has

been in the past. These methods will probably permit the synthesizing of a host variety with almost any desired genic combination. But in so synthesizing a variety, due regard will have to be paid to the corresponding genic synthesis that nature is likely to bring about in the rust organism. The plant breeder cannot afford to forget that he is guiding the pathogenic evolution of the rust.

References and Notes

1. This article is contribution No. 66 from the Canada Department of Agriculture Research Station in Winnipeg.
2. J. Eriksson, *Ber. deut. botan. Ges.* **12**, 292 (1894).
3. M. N. Levine and E. C. Stakman, *J. Agr. Research* **13**, 651 (1918); E. C. Stakman and F. J. Piemeisel, *Phytopathology* **7**, 73 (1917); E. C. Stakman and M. N. Levine, *Minn. Univ. Agr. Expt. Sta. Tech. Bull. No. 8* (1922); E. C. Stakman, M. N. Levine, J. G. Leach, *J. Agr. Research* **16**, 103 (1919).
4. E. C. Stakman, F. J. Piemeisel, M. N. Levine, *J. Agr. Research* **15**, 221 (1918).
5. H. K. Hayes, E. R. Ausemus, E. C. Stakman, C. H. Bailey, H. K. Wilson, R. H. Bamberg, M. C. Markley, R. F. Crim, M. N. Levine, *Minn. Univ. Agr. Expt. Sta. Bull. No. 325* (1936).
6. E. S. McFadden, *J. Am. Soc. Agron.* **22**, 1020 (1930).
7. R. H. Biffen, *J. Agr. Sci.* **1**, 4 (1905).
8. J. A. Clark and E. R. Ausemus, *J. Am. Soc.*

- Agron.* 20, 152 (1928); C. H. Goulden, K. W. Neatby, J. N. Welsh, *Anat. Record* 37, 182 (1927), abstr.; —, *Phytopathology* 18, 631 (1928).
9. J. H. Craigie, *Phytopathology* 21, 1001 (1931).
10. M. Newton, T. Johnson, A. M. Brown, *Sci. Agr.* 10, 721 (1930); E. C. Stakman, M. N. Levine, R. U. Cotter, *Sci. Agr.* 10, 707 (1930).
11. T. Johnson and M. Newton, *Can. J. Research* C18, 599 (1940).
12. H. H. Flor, *J. Agr. Research* 73, 335 (1946); 74, 241 (1947).
13. —, *Science* 124, 888 (1956).
14. I. A. Watson and D. Singh, *J. Australian Inst. Agr. Sci.* 18, 190 (1952).
15. N. E. Borlaug, *Proc. Intern. Symposium on Wheat Genetics, 1st Symposium, Winnipeg* (1958), pp. 12-27.
16. N. G. Vakili and R. M. Caldwell, *Phytopathology* 47, 536 (1957), abstr.
17. I. A. Watson and N. H. Luig, *Proc. Linnean Soc. N. S. Wales* 83, 190 (1958).
18. G. Pontecorvo, *Ann. Rev. Microbiol.* 10, 393 (1956).
19. E. R. Sears, *Am. Naturalist* 87, 245 (1953); *Proc. Intern. Symposium on Wheat Genetics, 1st Symposium, Winnipeg* (1958), pp. 221-229.

Personality and Scholarship

The traits of able students at colleges productive of scholars are different from those of other able students.

Paul Heist, T. R. McConnell, Frank Matsler, Phoebe Williams

Objective studies of the product of the educational process in America's colleges and universities are relatively few. The report by Learned and Wood of a study of the "academic growth of the baccalaureate mind" is still the most comprehensive assessment of the output of higher education that has been published (1). Two decades ago they demonstrated amazing differences in achievement among the students attending the various colleges in a single state.

More recent landmarks are the studies by Knapp *et al.*, which showed that a relatively small number of higher institutions in the United States were much more productive of scientists and scholars than the great majority of colleges and universities. The index of institutional productivity devised by Knapp and Greenbaum was the number of students per thousand graduates from 1946 to 1951 who later received either (i) Ph.D. degrees, (ii) university fellowships, (iii) government fellowships, or (iv) private foundation fellowships exceeding \$400 per year. Fifty institutions with the highest indices for male

graduates and 13 with the highest indices for female graduates were designated as institutions of high productivity.

Knapp and Greenbaum suggested some reasons for the striking differences in educational productivity they discovered. Although they did not disregard the quality of the students attracted to the most productive colleges in attempting to explain the institution's records, they nevertheless put the greater emphasis on the institutions—the faculty, the objectives, and the intellectual atmosphere. In referring specifically to the exceptional productivity of a few small liberal arts colleges, they spoke of their "singular hospitality to intellectual values in general" and declared that "the climate of values sustained by the institutions elevated the scholar and intellectual to the position of 'culture hero'" (2).

While serving as a member of a planning committee for research on diversification of American higher education at the Center for the Study of Higher Education of the University of California, Berkeley, Darley shifted the explanation for differential productivity from the institution to the student when he said (3): "Without cynicism, one might state that the merit of certain

institutions lies less in what they do to students than it does in the students to whom they do it."

Subsequently, a study by Holland (4) lent support to this hypothesis. After comparing certain characteristics of National Merit Scholarship winners and near-winners who attended colleges having "high" and "low" indices of productivity, he concluded that differential institutional productivity is a function of the concentration in certain institutions of exceptionally able students with high scholastic motivation. Holland, in another study, also found that the parents of National Merit Scholarship students who attended colleges which ranked high in productivity placed a high value on "learning how to enjoy life, and developing mind and intellectual abilities," while those whose children went to colleges which ranked lower placed less emphasis on intellectual goals (5).

In several research projects the Center for the Study of Higher Education has explored the hypothesis that particular colleges and groups or types of institutions are differentially selective, not only with respect to scholastic aptitude but also with respect to attitudes, values, and intellectual dispositions. The study reported here was devised to test the general hypothesis that highly productive institutions, by the criteria of Knapp and Greenbaum, are more attractive than less productive ones to National Merit Scholarship students with high scores on certain personality tests designed to measure attributes closely related to intellectual orientation and intellectual functioning.

The Sample

The population of students of high ability from which the sample for the study was drawn consisted of all the winners and a 10-percent sample of those who received certificates of merit (the near-winners) from the National Merit Scholarship Corporation in the

Dr. Heist, Dr. McConnell, and Miss Williams are on the staff of the Center for the Study of Higher Education, University of California, Berkeley. Dr. Matsler is on the staff of Humboldt State College, Arcata, Calif.

spring of 1956. The longitudinal investigation of the 1956 sample has been conducted with the cooperation of the staff at the National Merit Scholarship Corporation, and the students in this sample were a part of the larger group used by J. L. Holland (4). In the latter part of the summer of 1956 the students, 956 in number, were invited to participate in one of the Center's investigations of the development of exceptional students during their college careers. Those who acquiesced were mailed packets containing tests and questionnaires on two occasions, the first immediately prior to college entrance and the second just before completion of the first year in college. Almost 90 percent (843 of the students who were invited to participate) returned their tests and questionnaires on both occasions.

The students who entered the Massachusetts Institute of Technology and the

California Institute of Technology were omitted in the study under consideration. Of the remaining students, 216 males and 52 females enrolled in the highly productive institutions. The distribution of students among those institutions is shown in Table 1. The institutions are listed in the order of the Knapp and Greenbaum indices of productivity. It may be noted that about 70 percent of the 216 male students attended the ten most productive institutions. This enrollment represents about 25 percent of the more than 600 males in the total group of National Merit Scholarship students under study.

The total sample of 268 men and women entered only 31 institutions. This represents a high concentration of students of exceptional ability in a small number of colleges and universities, a finding which corresponds to the distribution of National Merit Scholarship students reported by Holland (4).

Because the sample comprised both scholarship winners and near-winners, it is important to note the proportions falling into the two subgroups. Of the 268 students, 36.4 percent of the men and 38.6 percent of the women had been awarded Certificates of Merit. Of greater concern is the matter of equivalence in ability of the winners and near-winners. Differences in scholastic aptitude between the two groups could invalidate a comparison of the differential characteristics of students in high and low institutions, since 71.8 percent of the male winners attended the high-productivity institutions in comparison with only 28.2 percent of the near-winners; for the males in the low-productivity institutions, the corresponding percentages are 38.6 percent and 61.4 percent, respectively. The higher percentages of winners in the high-productivity sample may be due in large part to the fact that the scholarships had permitted them a greater choice in the selection of schools.

Since measured aptitude was a criterion in selecting the scholarship winners, the combined mean scores (verbal plus mathematical) of both men and women on the Scholastic Aptitude Test were significantly higher in the case of the winners. However, with the exception of one personality scale—Complexity of Outlook—upon which female winners scored higher than near-winners, the difference in scholastic aptitude was the only significant one. The differences in aptitude between winners and near-winners and the dif-

Table 2. Means and standard deviations (SD) on the total score (verbal and mathematical combined) of the Scholastic Aptitude Test for matched groups of male and female students attending institutions ranked high and low in production of scientists and scholars.

Rank of institution	Males (N = 50)		Females (N = 41)	
	\bar{X}	SD	\bar{X}	SD
High	138.78	5.8	139.2	8.6
Low	138.84	5.7	139.6	8.0

ferences in the percentages of winners (or near-winners) attending the high- and the low-productivity institutions produced different mean aptitude scores for the students attending schools in the two groups. Because of this, samples of males and females in the two productivity categories were matched on total Scholastic Aptitude Test scores (verbal and mathematical combined) by drawing students at random from the low-productivity institutions and pairing them with students from the high-productivity institutions. The mean aptitude scores of the four groups are presented in Table 2.

The matching resulted in groups whose mean scores were approximately halfway between the mean aptitude test scores of the total groups of males and females ($N = 216$ and 52) attending the high-productivity institutions and the total groups in the low-productivity institutions. A greater attenuation of the aptitude scores of male students in the higher ranking institutions suggests that this high-ability group ($N = 216$) is probably under-represented in the matched sample, and indeed, proportionally more of the less capable students from the original high-productivity group do fall into this matched subgroup of 50 students.

There were, of course, other variables upon which students could have been matched for greater comparability of the groups. However, matching on more than one variable at a time would have resulted in groups too small for satisfactory comparison.

Available Data

Included in the first packet of material sent to the students, in the late summer of 1956, were a questionnaire covering biographical, socioeconomic, and attitudinal items, the Strong Vocational Interest Blank (SVIB), and an Omnibus Personality Inventory (OPI)

Table 1. Distribution of male and female National Merit Scholarship students among institutions ranked high in the production of scientists and scholars.

School	NMS students	
	No.	No. per 1000
<i>Males</i>		
Swarthmore	10	7
Harvard	64	5
Haverford	5	4
Oberlin	11	4
Reed	4	4
University of Chicago	8	3
Carleton	3	2
Princeton	21	2
Yale	23	2
Wesleyan	4	2
Knox	3	2
Cornell	22	2
Pomona	2	2
Grinnell	2	1
DePauw	3	1
Amherst	4	1
Williams	4	1
Johns Hopkins	4	*
University of the South	1	*
Columbia	4	*
Augustana (Ill.)	1	*
Brooklyn	1	*
Brown	4	*
University of Pennsylvania	3	*
Dartmouth	5	*
Total	216	
<i>Females</i>		
Swarthmore	7	6
Radcliffe	14	5
University of Chicago	5	3
Cornell	7	2
Bryn Mawr	2	1
Vassar	3	*
University of Pennsylvania	1	*
Mt. Holyoke	4	*
Smith	6	*
Grinnell	1	*
Barnard	2	*
Total	52	

* More than 0 but less than 1.

Table 3. Omnibus Personality Inventory means and standard deviations (in parentheses) for National Merit Scholarship males and females attending institutions of high productivity (HP) and low productivity (LP).

OPI scale	Males (N = 50)			Females (N = 41)		
	HP	LP	t	HP	LP	t
Schizophrenia*	12.14(7.6)	11.66(5.8)		9.73(5.4)	11.59(6.5)	
Hypomania*	16.80(4.8)	17.14(3.7)		14.68(3.2)	16.15(4.3)	
Social Introversion	22.92(8.3)	25.94(9.7)	2.29†	24.85(7.9)	26.93(8.5)	
Thinking Introversion	47.44(7.2)	46.06(7.8)		49.71(5.7)	46.27(8.8)	2.23†
Responsibility	41.64(6.4)	41.62(3.7)		43.71(3.0)	44.40(5.2)	
Complexity of Outlook	15.64(4.1)	13.96(3.3)	2.79‡	16.71(3.6)	14.90(3.5)	2.87‡
Originality	25.86(4.1)	24.16(4.4)	3.20‡	26.20(3.3)	25.68(3.7)	
Authoritarianism (F)	7.24(3.9)	9.02(3.7)	2.12†	5.28(2.7)	7.95(3.7)	3.35‡
Ego Strength	22.46(2.7)	21.92(2.8)		23.30(2.6)	21.76(2.6)	2.68‡
Authoritarianism (F4)	17.86(4.3)	18.96(7.1)		15.48(3.6)	17.51(4.1)	2.16†
Impulse Expression	19.88(8.2)	18.10(7.4)		17.25(6.0)	18.83(6.7)	

* Scales not corrected by K value. † $p < .05$. ‡ $p < .01$.

(6). The latter instrument was assembled particularly for this project and for other studies of students of superior ability. At the end of the spring term of their freshman year, the students were asked to respond to another questionnaire, composed chiefly of attitudinal items, and the Allport-Vernon-Lindzey Study of Values (AVL) (7). Additional biographical data, Scholastic Aptitude Test scores, and some pertinent information from the students' high school records were obtained through the cooperation of the National Merit Scholarship Corporation. The analyses for this report were limited to scores on three objective inventories: the Strong Vocational Interest Blank, the Omnibus Personality Inventory, and the Allport-Vernon-Lindzey Study of Values.

Hypotheses

The specific hypotheses concerning differences in characteristics between students in the high- and low-productivity institutions are given below. The content and "direction" of these hypotheses were derived from conclusions and implications in the studies by Knapp *et al.* (2, 8), some general knowledge of the institutions in the high-productivity group, and some evidence on the academic adjustment and attainment of the more liberal, free-thinking, and nonauthoritarian student (9).

1) The students in the high-productivity institutions should have significantly higher mean scores than those in the low-productivity institutions on the following personality variables, all included as scales in the Omnibus Personality Inventory: Schizophrenia, Hypomania, Thinking Introversion, Origin-

ality, Complexity of Outlook, Ego Strength, and Impulse Expression.

2) The students in the high-productivity institutions should have significantly lower mean scores than those in the low-productivity schools on the following Omnibus Personality Inventory scales: Social Introversion, Responsibility, and Authoritarianism (both F and F4).

3) The students in the high-productivity schools should have significantly higher mean scores than those in the low-productivity colleges on the Theoretical and Aesthetic scales of the Allport-Vernon-Lindzey Study of Values and a significantly lower mean score on the Religious scale.

4) There should be significant differences between students in the high- and low-productivity schools in the prevalence of theoretical and applied patterns of responses on the Strong Vocational Interest Blank (10, 11).

Results

Tables 3 and 4 present the means on the Omnibus Personality Inventory and AVL Study of Values scales, in addition to *t* values for all scales yielding differences significant at or beyond the .05 level. On the OPI, the male groups in the high- and the low-productivity institutions differed significantly on four scales, and on the AVL there were significant differences for two of the three traits tested. The males in the high-productivity group scored higher on the OPI scales of Complexity of Outlook and of Originality and lower on Social Introversion and Authoritarianism (F). On the AVL, the males in the high-productivity group scored higher on the Theoretical and Aesthetic

scales and lower on the Religious scale.

The results for the females on these inventories were in general agreement with those for the males. The females in the high-productivity group also scored higher on the Aesthetic and lower on the Religious scales of the AVL (the difference on the Theoretical scale approached the .05 level). On the personality inventory the differences on the Complexity of Outlook and Authoritarianism (F) scales are again significant, and in the same direction as the results for the men. On a second scale measuring authoritarianism (F4) (12), the women in the high-productivity group had significantly lower scores than those in the other group. In addition, they scored higher on two other scales—Thinking Introversion and Ego Strength.

In the case of the male groups, the scale variances were homogeneous in all instances. In the case of the females, however, the variances on both the Authoritarianism (F) and the Thinking Introversion scales were significantly different at the .10 level. For the reader unacquainted with personality measurement it should also be added that the differences obtained must be interpreted with a concern both for the amount of the difference and the amount of the overlap of scores in the two distributions. However, where the differences are significant, a majority in one group receive scores quite unlike those of a majority in the second group.

One may conclude that the first two hypotheses are supported by the data for both sexes on only the Complexity of Outlook and the Authoritarianism (F) scales. For the males, the hypotheses are supported on the Originality and the Social Introversion scales. For the females, the differences on Thinking Introversion, Ego Strength, and Authoritarianism (F4) are in line with expectations. Except for the Theoretical scale, the third hypothesis is supported for both sexes. In a previous analysis of comparable data for all students (that is, before matching on Scholastic Aptitude Test scores), significant differences were found for both sexes on all the scales which yielded significant differences after matching, with the exception of the differences on Social Introversion.

Weissman's method of analyzing Vocational Interest Blank scores on a theoretical-applied dimension was validated only for the men's form on a

male sample (10, 11). Nevertheless, in line with the theory that the form for men can be used in counseling females of superior ability who have a strong career orientation (13), Weismann's technique of profile analysis was also used with the women in this study.

The Vocational Interest Blank profiles of the 100 males and 82 females were subjected to a "blind" analysis—that is, they were read, interpreted, and classified before the respective groupings by high- and low-productivity institutions were known. The assignment to categories in this method of profile analysis, in the great majority of cases, is readily determined by relatively objective criteria; interpretive judgment is infrequently involved. The assignments were made independently by two judges, and the two or three discrepancies resulting from the independent work were resolved through later discussion and agreement between the judges.

The frequencies for males and females in the various categories are presented in Table 5. Chi-square analysis was employed to test the hypothesis that the obtained distributions of the frequencies in the major categories differed from the distributions to be expected on the basis of chance. The chi-square values are 10.04 ($p < .01$) and 8.60 ($p < .02$) for the males and females, respectively. Thus, for both sexes, the number of individuals in the major categories is significantly different from the number expected on the basis of chance, a much larger number of students in the high-productivity groups falling in the A category. For both sexes the distinctive differences are in the A0 and A2 subcategories. For the males, the frequencies in the C category differ considerably, with five times as many individuals in the low- as in the high-productivity group. For the females, the second major difference is found in the B category, which contains almost twice as many individuals of the low- as of the high-productivity group. It is of interest to note the frequencies found in the subcategories under the general A and B classifications; they appear to shed some light on the meaning of these distributions. For example, the combined totals in the A0 and A2 categories for males and females in the high-productivity groups (20 in each case) as compared to similar totals in the low-productivity groups (7 in each case) are striking,

Table 4. Allport-Vernon-Lindzey Study of Values means and standard deviations (in parentheses) for National Merit Scholarship males and females attending institutions of high productivity (HP) and low productivity (LP).

AVL scale	Males (N = 50)			Females (N = 41)		
	HP	LP	t	HP	LP	t
Theoretical	48.66(9.7)	46.12(7.7)	1.71*	45.37(7.4)	43.00(8.4)	
Aesthetic	43.50(11.6)	36.20(9.3)	4.15†	49.98(8.7)	45.85(9.9)	2.50†
Religious	39.74(11.6)	46.14(10.3)	2.22*	42.51(8.5)	48.15(11.14)	2.23*

* $p < .05$. † $p < .01$.

especially since no such differences are found in the A3 category for either sex. The seemingly consistent direction of the small differences in the B4 and B5 categories for both sexes should also be noted. Certain other differences appear to be peculiar to one sex or the other and are probably related to differences in the orientation of men and women toward future occupations.

Discussion

That higher institutions are differentially selective with respect to general scholastic aptitude is well established, but relatively few studies have been made of the distribution of such student attributes as values, attitudes, and personality characteristics among particular institutions or groups of institutions. Holland, as noted above, showed that highly productive colleges drew National Merit Scholarship students with higher average Scholastic Aptitude Test scores than the less productive institutions. Holland has also reported the relationship of scores on the California Psychological Inventory and the choice of an institution of high rank on the Knapp-Goodrich and Knapp-Green-

baum indices of productivity. He concluded that "the choice of a high ranking institution is positively associated with a sense of well-being, psychological-mindedness (sensitivity to others), flexibility, good impression, non-stereotypy, and is negatively associated with socialization (propriety)" (5). However, he reported that most of the relationships were not found in more than one sample and that the correlations were in all cases small—the two highest were .28 for non-stereotypy and .21 for psychological-mindedness. In view of the fact that the students in schools of high and low productivity were matched on Scholastic Aptitude Test scores, this study supplies rather striking evidence of differential selectivity or attraction with respect to a number of personality characteristics. The pattern of differences in these characteristics is summarized below.

In previous research, scores on an instrument such as the Minnesota Multiphasic Personality Inventory (MMPI) have resulted in minimal or no differences among institutional groups. The general picture of mental health and emotional stability appears to be very similar for student bodies in different

Table 5. Numbers of National Merit Scholarship males and females, categorized by profile analysis of Strong Vocational Interest Blank, attending institutions of high productivity (HP) and low productivity (LP).

Category	Males (N = 50)		Females (N = 41)	
	HP	LP	HP	LP
A: Theoretical				
A0 (abstract)	6	0	11	3
A2 (scientific)	14	7	9	4
A3 (social)	3	3	10	11
Total	23	10	30	18
B: Applied—professional				
B1 (biological science)	5	1	0	4
B2 (technical)	3	12	2	2
B3 (welfare)	8	7	5	9
B4 (business)	4	8	0	5
B5 (verbal)	4	1	4	0
Total	24	29	11	20
C: Applied—technical	2	11	0	0
Reject	1	0	0	3

colleges, and, incidentally, quite normal. The results for these multi-institutional high- and low-productivity groups on the MMPI Schizophrenia and Hypomania scales are in line with these previous findings, and the lack of differences on the Impulse Expression scale—a measure of the general readiness to express impulses—may be considered supportive of the same finding. The scores on two other scales—Social Introversion and Ego Strength—both composed of items from the MMPI, also support the picture of mental health in the student bodies of schools of both groups. Though the difference on the Social Introversion scale is significant only for the males and on the Ego Strength scale only for the females, the direction of the differences on both scales is the same for both sexes. It can be inferred from content analysis and validity studies of these scales that there is more inner-directedness and social independence in individuals from the high-productivity institutions. This seems to be in line with what might be predicted from differences in other characteristics between students in the two kinds of institutions.

The other differences discovered can be viewed as reflecting an orientation favorable to learning and intellectual activity among those selecting high-productivity institutions. For example, whatever the "true" meaning of the Authoritarianism (F) scale—whether it indicates rigidity, conventionality, and so on, or whether (at the other extreme) it largely reflects educational and cultural sophistication or "response set"—the differences obtained, in conjunction with those obtained on the AVL Study of Values Religious scale, which assesses a degree of fundamentalism and dogmatism, make it possible to draw a fairly simple conclusion. The scores of students in the high-productivity institutions indicate more freedom and receptivity to learning, more objectivity, and less conservatism and authoritarianism.

The major components of the pattern of differences referred to as a positive orientation toward learning are further supported by the distributions across the Vocational Interest Blank categories presented in Table 5. The high-productivity colleges have a greater number of both males and females in the A, or theoretical, category, and particularly in the subcategories, A0 and A2 (abstract and scientific). These

people may be described as possessing intellectual curiosity and a spirit of inquiry, as being concerned with ideas and theory, and as being disposed toward speculative and creative thought. In addition, interesting differences are found in the biological science (B1) category for the males and in the verbal (B5) category for the males and the females, but the number involved and the size of the differences are not sufficient to warrant supportive interpretations of the differences in intellectuality between the two groups.

In contrast, the frequencies in the low-productivity schools are concentrated more in the major applied-technical area (C) and in the technical (B2) and business (B4) subcategories for the males; for the females, almost twice as many individuals from the low- as from the high-productivity group are found in the broad applied-professional (B) category, in which the major differences are in the biological science (B1) and business (B4) subcategories. Thus, there is a greater concentration of students with theoretical and nontechnical Vocational Interest Blank patterns in the high-productivity institutions and of students with patterns in the applied, and especially in the technical, areas in the low-productivity schools.

The differences on the Aesthetic scale of the AVL Study of Values are consistent with the differences in the Vocational Interest Blank findings. Work at the Center for the Study of Higher Education has indicated that the Aesthetic scale is more closely related to serious intellectual and scholarly interests than is the Theoretical scale, although a high score on *both* scales is especially indicative of intrinsic intellectual interests, and possibly of a creative disposition (14). In the study under discussion, more than twice as many individuals of both sexes in the high-productivity institutions as in the low-productivity group are at least one standard deviation above the college-student mean on both of these scales.

Both male and female students in the high-productivity schools had significantly higher scores on the Complexity of Outlook scale. The established correlates of this scale indicate (6) that high scorers may be described as independent, critical, liberal, somewhat unconventional, interested in artistic things, tolerant of ambiguity, receptive to the new and the different, and

potentially original and creative. The results on two additional scales supplement this picture. The males in the high-productivity schools score higher on the scale measuring a disposition toward originality, and the females in these schools score higher on the Thinking Introversion scale, which assesses the degree of preference for reflective thought, particularly of an abstract nature. The data round out the picture of intellectuality and potential creativity of the students in the highly productive institutions.

The colleges which are noted for the production of future scientists and scholars start with students who apparently have a considerably greater inclination for the intellectual life. The "output" of these colleges must therefore be seen in relation to the "input." This does not necessarily mean that the merit of such a college is in its students rather than in what it does to them, any more than it implies that the character of the institution is of no consequence. As a matter of fact, Thistlethwaite (15) has shown that the productive colleges have rather special cultural characteristics, and that the climate of the institutions which are especially known for turning out future natural scientists differs in certain ways from that of the ones which are noted for the production of social scientists and humanists. The most likely hypothesis is that the productivity of these schools is the outcome of a fortunate combination of faculty and student expectations, interest, and values. This is one major hypothesis which the Center for the Study of Higher Education is testing in its investigation of student development in some eight institutions, including small liberal arts colleges, a large state college, and a complex state university.

Summary

Two groups of National Merit Scholarship students were selected on the basis of attendance at educational institutions ranked high or low in the production of future scholars and scientists. Four hypotheses pertaining to expected personality differences between matched groups from both sources were explored by means of the following instruments: the Omnibus Personality Inventory, the Strong Vocational Interest Blank, and the Allport-Vernon-Lindzey Study of Values. In general, the hypotheses were firmly supported, and

it was concluded that students of high ability attending highly productive institutions have a pattern of traits, values, and attitudes which is more closely related to serious intellectual pursuits than have students of high ability attending less productive institutions (16).

References and Notes

1. W. S. Learned and B. D. Wood, *The Student and His Knowledge* (Carnegie Foundation for the Advancement of Teaching, New York, 1938).
2. R. H. Knapp and J. J. Greenbaum, *The Younger American Scholar* (Univ. of Chicago Press, Chicago, 1953), p. 97.
3. J. D. Darley, "Diversification in American higher education," *Proc. Anniversary Conf. National Assoc. Student Personnel Administrators, 38th Conf.*, Lawrence, Kan. (1956), pp. 45-66.
4. J. L. Holland, *Science* 126, 433 (1957).
5. ———, *College and University* 1959, fall, 11 (1959).
6. P. Heist and P. A. Williams, unpublished manuscript.
7. G. W. Allport, P. E. Vernon, G. Lindzey, *Study of Values: A Scale for Measuring the Dominant Interests in Personality, Manual of Directions* (Houghton Mifflin, Boston, rev. ed., 1951).
8. R. H. Knapp and H. B. Goodrich, *Origins of American Scientists* (Univ. of Chicago Press, Chicago, 1952).
9. G. G. Stern and A. H. Cope, paper read before the American Psychological Association, Chicago, Sept. 1956; H. E. Titus and H. P. Hollander, *Psychol. Bull.* 54, 47 (1957).
10. M. P. Weissman, thesis, University of California (1958).
11. Weissman devised a method of classification of responses on the Strong Vocational Interest Blank on a theoretical-applied continuum representing intellectual disposition or orientation scores. There are three major categories of disposition, with a number of subcategories under the first two. Included under category A are the profiles representing a theoretical and abstract orientation. The other two categories represent a less theoretical and more applied orientation, B being distinguished from C chiefly on the basis of "more applied dispositions at professional rather than technical levels of responsibility." The system makes it possible to assign each profile of scores to a single category. The names of the categories and brief characterizations are as follows:
 A: Theoretical. A0, abstract: intellectual curiosity centers on the world of ideas, concepts, and theory, often without tangible subject focus. A2, scientific: intellectual activity involves speculative and creative thought, the spirit of inquiry, and the scientific "method"; intellectualism centers on science and especially scientific research. A3, social: intellectual interests center on social institutions, customs, and behaviors.
 B: Applied-professional. B1, biological: orientation is to the application of principles in a broad area of independent responsibility; focus is on medical, biological, and natural sciences. B2, technical: orientation is to application and independent responsibility in technical fields. B3, welfare: orientation is to application and independent responsibility in work with people. B4, business: orientation is to application and independent responsibility in business. B5, verbal: orientation is to application and independent responsibility in "verbal" activities, often of a political or economic nature.
 C: Applied-technical. orientation is to application but with limited aspirations for responsibility. Interests are in active, outdoor, technical, or mechanical affairs.
12. N. Sanford, H. Webster, M. Freedman, *J. Psychol.* 40, 73 (1955).
13. J. G. Darley and T. Hagenah, *Vocational Interest Measurement: Theory and Practice* (Univ. of Minnesota Press, Minneapolis, 1955).
14. D. W. MacKinnon in "Selection and Educational Differentiation," *Proc. Conf. Selection and Educational Differentiation*, Berkeley, Calif. (1960).
15. D. L. Thistlethwaite, *Science* 130, 71 (1959).
16. The collection and analysis of data discussed in this study were part of a larger project made possible through a grant from the Carnegie Foundation. Drs. John Darley, Elwin Farwell, and Harold Webster and Mr. George Yonge served as consultants for the project and the study.

Science in the News

Kennedy's Economics: The Dismal Science Made Cheery; Science, Education, and Economic Growth

There are a number of points in common between the Economic Report that President Kennedy presented to Congress last week and the report that President Eisenhower presented 2 days before he left office, which is interesting, because the policy recommendations made in the two reports, despite the common agreements, are miles apart.

Both start with the same data: that unemployment is high, production has declined. Both agree that a moderate upturn is likely in the coming months, even if the government does nothing special to stimulate the economy. Both accept the idea of government intervention in the national economy: the Eisenhower report speaks approvingly

of "a keener awareness [since the war] of approaching downturns and a determination to meet them by positive action rather than by passive acceptance."

Both reports agree that deficit spending can help stimulate the economy: the Eisenhower report notes, as one of the policies that helped stop the 1958 decline, that "a substantial deficit was incurred." Both agree on the need for support of such things as science and education as part of a program for economic growth: the Eisenhower report notes the requirement for "a huge expansion of the Nation's commitment to education." And both agree on the need to control inflation: the Kennedy report calls inflation "a cruel tax upon the weak . . . the certain road to a balance of payments crisis and the disruption of the international economy of the Western World."

This list could easily be doubled in

length while still confining itself to major points of agreement on economic facts and principles, and what it proves, in the main, is the wisdom of General Marshall's plea: "Don't ask me to agree in principle; that just means we haven't agreed yet."

The Dismal Science

Thomas Carlyle gave economics its familiar tag, the dismal science, at a time when one of its implicit axioms was that the mass of men are necessarily condemned to existence at a bare subsistence level.

That axiom has become obsolete. No one today accepts the inevitability of permanent economic misery even for the undeveloped nations, and the conditions of mass poverty have already largely disappeared in the more advanced countries. But a remnant remained in the Eisenhower Administration in the form of a conviction that full employment is inconsistent with preserving the value of the dollar, a conviction that grew out of the well-observed tendency for prices to rise before reasonably full employment, say not more than 4 percent unemployment, had been reached.

This suggested that full employment would bring with it strong inflationary pressure, which in turn led an Administration passionately concerned with the value of the dollar to accept as one

of the dismal facts of economics what the Kennedy Administration now says should never be accepted: "We must never," says the Kennedy report, "... come to accept the proposition that reasonable price stability can be achieved only by tolerating a slack economy, chronic unemployment, and a creeping rate of growth."

The Eisenhower report, in much different language, endorses substantially the policy that Kennedy condemns: "Some temporary acceleration of growth might have been achieved," the report says, "if expectations of price increases had been allowed to persist and to become firmly rooted. But the unsustainable nature of such growth would now be confronting the economy with the need for far-reaching and painful correction."

Two Views

It was this sharp divergence in views that led Eisenhower to announce himself well satisfied with the recovery from the 1958 recession even though unemployment, at the peak of the recovery, remained half a million higher than it had been at the peak of the previous cycle two years earlier; Kennedy now calls this recovery "anemic."

The Eisenhower report confidently asserts that its policies "to maintain stability and balance" have succeeded in putting the economy in a position to look forward "to a period of sound growth from a firm base," while the Kennedy report claims, on the basis of Eisenhower's own figures, that his prediction of a resumption of sound growth implies that "unemployment would hover between 6 and 7 percent throughout the year," that is, there will be an extra million or two unemployed above what would be expected under reasonably full employment.

Both sides have freely resorted to euphemism and vague language to shield the less popular side of their views from the public: the Eisenhower people have never conceded in so many words that they accept the dismal view that a slack economy is the only answer to inflation, although their frequently stated satisfaction with the current trend of the economy allows no other conclusion; Kennedy has never bluntly told the public that in order to put his more cheery view of economics into practice he means to deliberately unbalance the budget to take up the slack in the economy; nor has he said, or even publicly hinted, that it is quite

possible, and perhaps inevitable, that he will have to ask for some form of wage and price regulation to control the inflationary pressure that will probably develop.

Instead Kennedy, while warning that the fiscal '61 and '62 budgets may not be in balance, has delicately blurred his intention to make sure that they will not be in balance. He has used, on several occasions, the curious phrasing that claims "the programs I am now proposing will not *by themselves* (italics added) unbalance the budget." All this means is that Kennedy thinks, and almost everybody, including the Wall Street Journal, agrees, that Eisenhower's proposals for the fiscal '62 balanced budget were achieved primarily by wishful thinking. No one even doubts any more that this was the case with the fiscal '61 budget. All Kennedy means by his claim that his proposals by themselves will not unbalance the budget is that the budget was probably going to be unbalanced anyway, even without his additional spending proposals.

Similarly, on inflation, Kennedy has announced the formation of a President's Advisory Committee on Labor-Management Policy as the instrument to try and control, through voluntary compliance, excessive wage or price increases; but it is most doubtful that anyone near Kennedy really believes that setting up an Advisory Committee will really be enough to deal with the problem. The committee is quite likely to be more useful in the long run as a means of publicizing the need for stronger action than as an effective instrument in dealing with inflation. Meanwhile, like the vague statements about next year's budget, it helps keep his potential opponents quiet for a while longer.

Conservatives and Keynes

The Eisenhower people, although willing to concede that deficits can help a recession, have never been able to bring themselves to really accept the idea of a deliberately unbalanced budget: even Hoover had unbalanced budgets, for they are hard to avoid when the economy is weak, but it is difficult for conservatives to cross the line from *accepting* an unavoidable deficit as useful to *planning* a deficit as desirable.

The idea of planned rather than unavoidable deficits to be balanced by a surplus in good times dates only from

the late 1930's, when the ideas of John Maynard Keynes began to take hold. Roosevelt apparently never accepted the idea, and regarded his own deficits as unfortunate necessities. Nevertheless, the Eisenhower Administration might have been willing to take up Keynes, despite its distaste for federal intervention in the economy, if only the problem of inflation didn't seem certain to accompany Keynesian stimulation of the economy: what was the use of taking up what is still regarded by conservatives as a radical fiscal policy if the strong economy you hoped to achieve through this policy would bring with it the necessity for a move even further left to keep a leash on prices and wages?

Kennedy's Position

The Kennedy Administration, though, has no qualms. The Kennedy people do not think the United States can afford a slack economy at a time when the world is watching and wondering if communism does indeed represent the wave of the future; on the level of practical politics they start by seeing the need for a wide and heavy variety of expenditures at home and abroad, and arrive at the conviction that stimulation of economic growth is a much easier way to get a big share of the money to pay for them than by having to ask for massive tax increases; indeed they are convinced that without a stronger economy what must be done will not be done, and that to accept Eisenhower's view is tantamount to accepting world-wide defeat.

They not only believe that the situation is bad now, but that it will get worse unless something is done: the Kennedy report points out that there should be a normal growth in productivity per man hour of about 2 percent a year, and a growth in the labor force of about 1½ percent a year. This adds to a potential growth rate of 3.5 percent, although the actual growth under Eisenhower has been only 2.5 percent.

Where has the excess gone? Partly, say the Kennedy people, into a slow increase of the level of unemployment which the nation has been told to accept as normal; partly it has simply failed to appear as businessmen have been unwilling to push investment that would produce increased productivity for an economy which offers no outlet for the extra goods produced.

The Kennedy people point out that since the late 1940's the rate of eco-

conomic growth, as measured from the peak of one business cycle to the next, has consistently declined, and that in more recent years a similar increase in the rate of unemployment at the peak of succeeding business cycles has also appeared.

Aside from this direct loss of economic growth, the Kennedy people say that a further increment to growth, above the normal 3.5 percent, has been ruled out by the Eisenhower policies. This increment, they say, is readily available if the nation will invest more money in such things as scientific research and education. The Eisenhower Administration has agreed in principle, but has felt the nation could not afford these investments, a feeling that was strengthened, of course, by that Administration's reluctance to raise the size of the federal budget and to increase the degree to which science, education, and other factors depend on the federal government.

The Kennedy people disagree: such investments, it is true, will unbalance the budget, which is just fine, in their view, for they feel the country needs a budget deficit. "Pledged expenditure programs that are desired for their own sake," said the Samuelson task force report, "should be pushed hard. If 1961-62 had threatened to be years of over-full employment and excessive inflationary demand, caution might require going a little easy on them. The opposite is in prospect."

So the outlook is for more money for a great many things, including science and education, and for a rousing political battle between the new Administration and the conservative opposition which is convinced that "you can't spend yourself rich." All of this has exhilarated the part of Washington that sympathizes with Kennedy, and has begun to appall his opponents.

The Kennedy people seem to glory in the size of the problems at home and abroad: they no more regret them than a mountaineer regrets that there are Everests to climb. "In the long history of the world," Kennedy said at his inauguration, "only a few generations have been granted the role of defending freedom at its hour of maximum danger. I do not shrink from this responsibility—I welcome it. I do not believe any of us would exchange places with any other people or any other generation." Whether he has his way or not is in question, but no one doubts that it will be a grand show.—H.M.

News Notes

Space: 7-Ton Sputnik; NASA Chief; Chimp's Rocket Trip; Samos and Minuteman Fired

Five days of major events in the history of space development culminated on 4 February in the Soviet launching of a 7.1-ton sputnik, the heaviest vehicle ever put into orbit. The period of space activity opened on 30 January with President Kennedy's selection of James E. Webb to succeed T. Keith Glennan as head of the National Aeronautics and Space Administration. The next day a chimpanzee made an 18-minute, 420-mile rocket flight and was successfully retrieved. On the same day, the Air Force sent a Samos reconnaissance satellite into polar orbit from Point Arguello, Calif., in the first successful launching of this experimental vehicle, designed to perform photographic missions. And on 1 February the Air Force fired a three-stage Minuteman intercontinental ballistic missile 4600 miles down range from Cape Canaveral, establishing it as the largest solid-propellant rocket ever fired in the Western world and the first major missile to be tested as a complete unit at its initial launching.

The Soviet Satellite

The new 14,000-pound sputnik was sent aloft with an "improved multistage rocket," according to the Soviet news agency Tass, which released very few details about the satellite, not even its radio frequencies. The vehicle is circling the earth once every 89.8 minutes in an elliptical path that has an apogee of 203.5 miles and a perigee of 138.9 miles. Tass reported that the orbit was "close" to the one intended, and that equipment aboard had "functioned normally." (The heaviest satellite launched so far by the United States was the 9000-pound Atlas, fired on 18 December 1959.)

NASA Head Named

The new space chief James E. Webb—a lawyer, businessman, and former government official—will relieve Hugh A. Dryden, who has been acting administrator of NASA since Glennan's resignation. Dryden will continue as deputy administrator of the space agency. [Glennan has agreed to serve as a special consultant to the Senate Space Committee, according to its new

chairman, Senator Robert S. Kerr (D-Okla.), who has been a business associate of Webb's.]

Webb is at present chairman of the Municipal Manpower Commission, a study commission financed by the Ford Foundation to determine how able men and women can be attracted to public service at the local-government level. He served the federal government as director of the Bureau of the Budget from 1946 to 1949 and as Under Secretary of State from 1949 to 1952.

Chimp's Space Trip

Ham, the 37-pound male chimpanzee who was rocketed over the Caribbean from Cape Canaveral, is apparently in good condition, although his flight capsule traveled 120 miles further than planned. The experiment was a first major test of the environmental control system to be used for Project Mercury. There have been reports that one of Mercury's six astronauts would make a trip similar to Ham's in late March. However, more chimpanzee flights are expected first.

Samos and Minuteman

The Samos reconnaissance satellite, which is designed to perform photographic missions formerly conducted by U-2 aircraft, is circling the earth every 95 minutes in a polar orbit that has an apogee of 350 miles and a perigee of 300 miles. The vehicle is expected to stay aloft a year. The orbital weight of the satellite is 4100 pounds, and the instrument package is believed to weigh 300 to 400 pounds.

This was the second attempt to orbit Samos. The first failed last October. The Samos program has been in operation 3½ years and has cost \$300 million.

The successful first test of the 60-foot Minuteman is of particular significance because this missile is intended to be the Air Force's principal weapon. It will have an eventual range of more than 6300 miles. There are reports that Air Force officials are especially elated over Samos and Minuteman because the two tests strengthen the Air Force's position in the competition for funds in the new Administration's first budget.

Atomic Energy Hearings Scheduled

The congressional Joint Committee on Atomic Energy has announced that public hearings on the development, growth, and state of the atomic energy



Argentine Marine Biological Station.

industry are scheduled for 21 February–2 March. Section 202 of the Atomic Energy Act of 1954 requires that the hearings be held within the first 60 days of each session of the Congress.

The Joint Committee will particularly consider the following subjects: (i) materials technology problems in the nuclear power industry (that is, fuel elements and materials for other reactor plant components); (ii) findings and recommendations of the recent McKinney report (particularly the need for greater coordination with atomic energy programs of our allies); (iii) industrial comments on regulatory problems (it is expected that public hearings will be held later on the Joint Committee Staff Report and other reports and recommendations on the AEC regulatory program); and (iv) industrial aspects of the nuclear space program.

It is expected that the chairman of the Atomic Energy Commission and other commissioners and staff of the AEC will lead off, beginning at 10 A.M. on 21 February and, if necessary, continuing on 23 February. Witnesses from industry and the public will be heard on 23, 24, 27, and 28 February and 1 and 2 March. This year all hearings will be held in the old Supreme Court chamber, Room P-63 of the Capitol, and with the exception of the first day's testimony by commission representatives, sessions will be scheduled only in the afternoons. Individual prepared testimony will be limited to about 15 minutes.

Letters of invitation are being sent to a number of the organization representatives, and others, who have appeared before the Joint Committee in the past, or who are active in those areas which the Joint Committee is particularly considering. The hearings will also be open to statements by other

qualified persons. Comments may be submitted in writing and will be included in the record for consideration by the committee. Oral testimony will be permitted in so far as time permits.

Persons interested in submitting comments or testifying before the committee during these hearings should contact George F. Murphy, Jr., of the committee staff, Room F-88, U.S. Capitol Building, Washington 25, D.C. before 14 February.

New Argentine Marine Biological Station at Puerto Deseado

Under the joint sponsorship of the University of Buenos Aires and the Instituto Nacional de Tecnología Industrial, the Marine Station at Puerto Deseado provides the first facilities for scientific study along the poorly known Patagonian coast. Located in the town of Puerto Deseado, on the estuary of Rio Deseado, it is now open to visiting investigators.

The station was originally founded in 1953, as a preliminary step toward the commercial utilization of marine plant resources of the area. In 1959, its organization was revised, and now its facilities are available for workers interested in all aspects of marine biology.

Although far from luxurious, the station is adequate for certain types of work. The three buildings and the prefabricated dormitory now under construction will provide sleeping accommodations for 15 people. There are three small kitchens, hot water, and heating stoves for winter use. There are eight rooms for use as laboratories. Some elementary chemical equipment, a small amount of glassware, herbarium materials, and simple collecting equipment are available. A 14-meter motor

launch with sleeping facilities, a small hydrographic winch, and a new truck are at present on order. Various other basic facilities and items of equipment are being assembled as funds become available.

Work being carried out at the Biological Station includes daily recording of surface temperatures and bimonthly collection of salinity, phytoplankton, and zooplankton samples at stations within the estuary of Rio Deseado. Marine botanical work includes systematic studies, the establishment of an algal herbarium, and preparation of exsiccatae for exchange purposes.

Although occupied throughout the year, the station is utilized mainly from January to April. The summer courses deal with systematics and ecology of benthic marine algae, invertebrate zoology, and phytoplankton. Students this year have the opportunity to work with senior visiting investigators from Uruguay, Chile, and Argentina. The director of the station is O. Kühneman of the department of botany, University of Buenos Aires; the station manager is T. Giannangili. Two laboratory assistants are in residence. In addition to the director, five biologists are at present listed as members of the summer faculty—Carmen Pujals, A. Asensi, La Coste de Diaz, R. Ringuet, and R. Pallares.

A number of species of marine birds, including the Patagonian penguin, *Spheniscus magellanicus*, nest a short distance from the station. In strong contrast to the barren, windswept Patagonian Desert, rich intertidal areas are exposed by large tidal fluctuations.

This new marine biological station certainly deserves attention as one that provides access to an interesting and little-known part of the South Atlantic.

MICHAEL NEUSHUL

Department of Botany,
University of Washington, Seattle

Conant To Conduct Teacher Education Study for Carnegie

A study of the education of teachers will be undertaken by James B. Conant, according to an announcement on Monday by the Carnegie Corporation of New York. Two reports on secondary education have already been issued by Conant, *The American High School Today* and *Education in the Junior High School Years*.

Conant decided to enter into this

new area largely because some of the leaders in the field of teacher education feel that such a study by him would be of great importance at the present time. Among the topics to be included will be the preparation of public school teachers and the criteria for their employment, as established by local, regional, and state education authorities.

On the staff for the first year will be John I. Goodlad, professor in the School of Education, University of California at Los Angeles, who will serve on a part-time basis; Jeremiah S. Finch, professor of English and dean of the college, Princeton University; William H. Cartwright, professor and chairman of the department of education, Duke University; Robert F. Carbone, instructor in the school of education, University of Chicago; and E. Alden Dunham, a member of Conant's staff for the past 3 years. The Educational Testing Service in Princeton, N.J., will administer the \$300,000 grant made by Carnegie for the study.

News Briefs

Teachers to Africa. Plans to send U.S. teachers to Africa in the next school year are being worked out by a group of foundations and educational institutions and the federal government. More than 400 teachers would be sent to Nigeria and the East African countries of Uganda, Kenya, and Tanganyika in the initial effort. The Carnegie Corporation of New York, the Ford Foundation, Columbia University Teachers' College, the African-American Institute, and the International Cooperation Administration are involved.

Polio immunization lags. Forty percent of the population, according to the latest Public Health Service estimates, has not been vaccinated against poliomyelitis. The estimate, based on a sample survey conducted by the Bureau of the Census in September 1960, shows that although 93 million persons under 60 years of age have received some vaccine, only about 25 percent have had the recommended full course of three shots, plus a booster.

The PHS is launching a vaccination promotion campaign, pointing out that such a campaign faces several difficulties. One is the fact that the majority of the unvaccinated are among the less privileged, in health matters the hardest

group to reach. Another is the imminent availability of oral vaccine, which has led many people to postpone the course of injections.

The American Medical Association is also concerned about the immunization program. At the recent AMA meeting in Washington a resolution was passed that called on physicians to cooperate in every possible way in a renewed campaign to stamp out poliomyelitis in this country.

Secondary-school math. Yale University has received a grant of \$1,184,200 from the National Science Foundation to continue support of a program to improve the teaching of mathematics in secondary and elementary schools. The School Mathematics Study Group, headed by Edward G. Begle, associate professor of mathematics at Yale, was initiated in the spring of 1958 by a grant from the foundation.

For its latest project, the group prepared teaching material which revises the curriculum for grades four through six. Some 370 teachers, operating in 27 centers from the eastern seaboard to the Far West, are teaching the new methods to more than 12,000 pupils.

Index of declassified reports. The Library of Congress has announced that an index to the recently declassified reports of the World War II Office of Scientific Research and Development has been printed and is for sale by the Office of Technical Services, U.S. Department of Commerce, Washington 25, D.C. The index is PB 161976 *Office of Scientific Research and Development Microfilm Index*, 770 pages, \$8 (\$2 additional for foreign mailing).

The index is a printed document but the reports themselves may be purchased only in microfilm or photocopy from the Photoduplication Service, Library of Congress, Washington 25, D.C.

A Roger Irving Lee professorship has been established in the Harvard University School of Public Health, honoring the chief architect in the planning of the school. University president Nathan M. Pusey announced the founding of the professorship at a recent dinner meeting attended by members of the Harvard Corporation and by close associates of Lee.

Fast reactions session at Cambridge. A summer session on "fast reactions" will be held in the department of phys-

ical chemistry at the University of Cambridge, 12-19 August. Among those contributing to the program of lectures will be R. G. W. Norrish, A. G. Gaydon, and T. M. Sugden. Further details may be obtained from: Secretary of the Summer School, Department of Physical Chemistry, Lensfield Rd., Cambridge, England.

Government graduate fellowships.

The U.S. Office of Education has announced approval of 527 National Defense Graduate Fellowship programs at 146 graduate schools for the 1960-61 academic year. These programs, authorized under title IV of the National Defense Education Act, are designed to increase the nation's supply of college teachers and to expand graduate facilities. The approved programs are in six fields; humanities, 26 percent; education, 8 percent; social sciences, 27 percent; biological sciences, 13 percent; physical sciences and mathematics, 16 percent; and engineering, 10 percent.

National Primate Center. The Public Health Service has awarded grants totaling \$1,917,275 for the construction and initial operation of a National Primate Center in Oregon. The center will be operated in conjunction with the University of Oregon Medical School, whose 100-monkey colony will form the nucleus of the 400-monkey facility.

Several additional primate centers are being planned, each to be affiliated with an established research institution. These centers are being developed as regional and national facilities and will be used by visiting scientists as well as by the permanent staff.

The chief purpose of these centers is to conduct research on primates, but they will also breed research animals.

AEC series on radiation. The Atomic Energy Commission has published the first in a series of pamphlets describing its biomedical program, which is directed toward the accumulation of knowledge of the effects upon living things of nuclear radiation from any source—natural or man-made. The booklet, titled *Marine Sciences Research*, was prepared under the direction of the commission's Division of Biology and Medicine. It summarizes work in progress at 13 institutions through 28 research contracts.

The new publication is available at 50 cents a copy from the Office of Technical Services, U.S. Department of

Commerce, Washington 25, D.C. The second and third booklets in the series will be devoted to AEC genetics and cancer research programs.

Grants, Fellowships, and Awards

Behavioral sciences. A Creative Talent Award of \$1000, and two of \$500 each, have been announced by the American Institute for Research, an independent, nonprofit organization devoted to basic and applied research in the behavioral sciences. The purpose of the program is to encourage the development of creative talent and the application of such talent to the advancement of the science of human behavior. Awards will be made annually to graduate students working for their doctor's degree in psychology or in a related field.

The outstanding doctoral dissertation in each of three areas of study will be selected annually by panels of distinguished scholars. On the basis of the three dissertations selected, the candidate judged as most likely to make creative contributions to scientific knowledge will receive an award of \$1000. The other two winning candidates will receive awards of \$500 each.

Dissertations completed during the period 1 July 1960–31 August 1961 will be eligible for the first annual awards. In subsequent years, the period will be 1 September–31 August. Completed nomination forms must be accompanied by an abstract of the dissertation. The forms will be made available through chairmen of graduate departments of psychology; they may also be obtained from the American Institute for Research, 410 Amberson Ave., Pittsburgh, Pa. A candidate may be nominated by his major adviser, the chairman of his department, or any member of the American Psychological Association.

For the first year, awards will be offered in the following three subject areas: perception, learning, and motivation; development, counseling, and mental health; and measurement and evaluation of individual and group behavior.

Cancer. The Ann Langer Cancer Research Foundation has announced the fourth annual award of \$500 for meritorious investigation in the field of cancer research, either clinical or laboratory. The award is being supported by the family of the late Bertha Goldblatt Teplitz and carries her name.

The competition is limited to physicians and other scientists under the age of 45. Nominations should be submitted to the Teplitz Award Committee, 612 N. Michigan Ave., Chicago 11, Ill., by 15 March. They should be accompanied by a 1-page statement and biography.

History of chemistry. Members of the American Chemical Society's Division of History of Chemistry, and other interested persons, are urged to consider the nomination of a candidate for the division's \$500 Dexter Award in the history of chemistry. The award is made on the basis of services which have advanced the history of chemistry in any of the following ways: by publication of an important book or article; by furtherance of the teaching of the history of chemistry; by significant contributions to the bibliography of the history of chemistry; or by meritorious services over a long period of time which have resulted in the advancement of the history of chemistry. Detailed information about nominees should be sent, in duplicate, by 10 March to the secretary of the Division of History of Chemistry, Sidney M. Edelstein, Dexter Chemical Corporation, 845 Edgewater Rd., Bronx 59, N.Y.

Physiological psychology. St. John's College, Cambridge, England, proposes by the end of April to make an election to the Kenneth Craik Research Award for the support of postgraduate research, preferably in physiological psychology. Candidates of either sex are eligible. The award recipient is not required to become a member of the college and need not reside at the university. If the college council consents, he may receive other emolument concurrently and may hold a salaried post.

The value of the award will be £450 a year. Tenure, which will date from 1 October 1961, will be for a period of not less than 1 year nor more than 3 years, as the council shall decide. Applications should be sent to The Master, St. John's College, Cambridge, to reach him not later than 1 April.

Radiation effects. A David Anderson-Berry Medal, together with a sum of money amounting to not less than £100 (\$280), will be awarded in 1961 by the Council of the Royal Society of Edinburgh. The prize will be given for recent work on the effects of x-rays and other forms of radiation on living tissues. Published work will be taken into consideration if submitted with the application.

Application for the prize may be

made directly, or proposals may be made on behalf of others. Applications and proposals must be in the hands of the General Secretary, Royal Society of Edinburgh, 22/24 George Street, Edinburgh 2, Scotland, not later than 31 March.

Scientists in the News

Logan Wilson, sociologist and chancellor of the University of Texas, has been elected president of the American Council on Education. He succeeds **Arthur S. Adams**, who became council president in 1951 and more than a year ago announced that he would retire as soon as a successor could be named. The new president will assume active leadership of the council not later than 30 June.

The American Meteorological Society presented six awards during its 41st annual meeting, held in New York, 23–26 January.

The Clarence LeRoy Meisinger Award went to **Verner E. Suomi**, professor of meteorology, University of Wisconsin, "for his imaginative and pioneering research work on atmospheric radiation problems in which he has effectively used both balloon and satellite observing platforms."

The society's Award for Applied Meteorology was presented to **Robert D. Elliott**, president, North American Weather Consultants, Santa Barbara, Calif., "for his effective leadership and outstanding administration in broadly pursuing opportunities for expanding meteorological research and its applications in private industry." The award is supported by the Weather Corporation of America.

The Award for Outstanding Services to Meteorology by a Corporation went to the Pacific Gas and Electric Company, San Francisco, Calif. Its citation read: "Pacific Gas and Electric Company has maintained an active support of private weather services since 1937. It is the first and probably only utility company in the United States that has made full use of weather facilities in its daily operations. It has also maintained an active interest in Meteorology research and has made substantive contributions in this area." **Francis J. Parsons, Jr.**, the firm's senior meteorologist, accepted the award for the company.

The Charles Franklin Brooks Award for Outstanding Service to the Society was conferred, posthumously, upon

Captain **Howard T. Orville**, USN, "for his devoted and long-standing service to the Society as President, Councilor and staunch supporter of all its activities. His enthusiasm, zeal and personal dedication contributed much to the expansion of the Society."

The Carl-Gustaf Rossby Award for Extraordinary Scientific Achievement was presented to **Victor P. Starr**, professor of meteorology, Massachusetts Institute of Technology, for "more than a decade of outstanding fundamental research leading to a better understanding of the general circulation of the atmosphere."

A special award given by the society for outstanding work went jointly to **William W. Kellogg**, chief, Planetary Sciences Group, Rand Corporation, Santa Monica, Calif., and **Stanley M. Greenfield**, at present on leave from Rand as scientific adviser to the U.S. Air Force Directorate of Research and Development, Washington, D.C., "for their pioneering work in the planning of a meteorological satellite."

Christopher E. Barthel, Jr., has been appointed program director for foreign science activities in the National Science Foundation's Office of Special International Programs. Before joining NSF, Barthel was assistant director of the Armour Research Foundation of Illinois Institute of Technology.

In April, **Elmer H. Bobst**, chairman of the board of Warner-Lambert Pharmaceutical Company, will receive the 1961 Rusby Award of the Columbia University College of Pharmacy Alumni Association.

The 1960 annual award of the American Society of Criminology was presented to **Thorsten Sellin**, president of the International Criminological Society, for "distinguished contributions to the science of penology," at the society's session in New York on 27 December during the annual AAAS meetings. Sellin is professor of criminology at the University of Pennsylvania and editor of the *Annals of the American Academy of Political and Social Sciences*.

In addition, two Vollmer research awards were presented, one to **Paul Bohannon**, Northwestern University anthropologist, for his study "African Homicide and Suicide," and one to **Marvin E. Wolfgang**, University of Pennsylvania criminologist, for his doctoral thesis, "Patterns of Criminal Homicide."

David H. Dunkle, Smithsonian Institution paleontologist, is in Pakistan to carry out special stratigraphic studies of vertebrate fossils, chiefly fishes, and to aid in the establishment and expansion of a paleontological branch of the Pakistan Geological Survey. Dunkle, on loan for 2 years to the U.S. Geological Survey, is a member of a seven-man Survey group sent to help the Pakistan Government improve its geological service. The U.S. team has headquarters at Quetta, where laboratories are being built for the Geological Survey of Pakistan.

Herman N. Eisen has been named head of the department of microbiology at Washington University School of Medicine, replacing **Arthur Kornberg**, 1959 Nobel laureate, who resigned in June of 1959 to head the department of biochemistry at Stanford School of Medicine. The appointment is effective immediately, although Eisen will not assume active duties as department head until July. He has been a member of the medical school staff since accepting the position of professor of medicine and head of the division of dermatology in 1955.

J. M. Burch, principal scientific officer, light division, National Physical Laboratory, England, will be in the United States from 28 February to 21 March. His itinerary includes Pittsburgh; Washington; Rochester, N.Y.; New York; Poughkeepsie, N.Y.; Norwalk, Conn.; and Cambridge, Mass.

H. J. Evans, member of the British Medical Research Council's scientific staff at the Radiobiological Research Unit, Atomic Energy Research Establishment, Harwell, is working at the Brookhaven National Laboratory for 1 year under an exchange agreement.

H. A. Gebbie, principal scientific officer, National Physical Laboratory, England, will be in this country in March to attend the Second International Conference on Quantum Electronics, which is being held at the University of California, Berkeley, 23-25 March. He will visit Chicago, Washington, and Cambridge, Mass.

Frank L. Schwartz, former professor of mechanical engineering at the University of Michigan and consultant to the Atomic Energy Commission, has been named director of engineering for Lauson Power Products Division of Tecumseh Products Corp., Tecumseh, Mich.

Mazhar Hasan, formerly assistant professor of physics at Northern Illinois University, has joined the Stromberg-Carlson Division of the General Dynamics Corporation as a senior physicist. He will do work in plasma physics in the division's Basic Science Laboratory.

Marshall Claggett, director of the University of Wisconsin's Institute for Research in the Humanities, has received the History of Science Society's annual Pfizer Award for an outstanding contribution to the history of science. He was honored for his book, *The Science of Mechanics in the Middle Ages*, published in 1959.

Recent Deaths

Franklin J. Crider, Sherman Oaks, Calif.; 78; plant scientist noted for his studies of the root, especially top growth patterns; designer, planner, and first director of the Boyce Thompson Southwestern Arboretum at Superior, Ariz., which he headed from 1924 to 1934; was prominent in the establishment of the U.S. Department of Agriculture's Soil Conservation Service, which he served until retirement in 1951; Jan.

Frederick L. G. Kollmorgen, Onancock, Va.; 89; an authority on precision optics; founded the Kollmorgen Optical Corporation in Brooklyn for the development and manufacture of precision optical and electromechanical instruments, including submarine periscopes and electronic firing control systems for weapons and missiles; Jan.

Carroll R. Mullen, Philadelphia, Pa.; 60; professor of ophthalmology and head of the department of ophthalmology at Jefferson Medical College; 1 Feb.

Karl E. Paschkis, Philadelphia, Pa.; 64; professor of physiology and clinical professor of medicine at Jefferson Medical College; director of the Division of Endocrine and Cancer Research at the college, and chief of the Endocrine Clinic at Jefferson Hospital; 27 Jan.

Jerome T. Syverton, Minneapolis, Minn.; 53; head of the department of bacteriology and immunology at the University of Minnesota; well known for his research on viruses and cell structure; taught at the University of Rochester and Louisiana State University, where he became head of the department of microbiology; 28 Jan.

Hugh C. Troy, Mountainside, N.J.; 93; retired professor of dairy industry at Cornell University; 27 Jan.

Book Reviews

McGraw-Hill Encyclopedia of Science and Technology. McGraw-Hill, New York, 1960. 15 vols. \$175.

An heroic amount of work went into the production of this large, comprehensive, multivolume encyclopedia of science and technology. The publisher's staff of 15 editors was guided by a distinguished editorial advisory board consisting of Roger Adams, Joseph Barker, Detlev Bronk, George R. Harrison, Sidney D. Kirkpatrick, William Rubey, and Edmund Sinnott. There were 64 consulting editors on special topics, for example, E. U. Condon on theoretical physics and E. L. Tatum on biochemistry. Over 2000 scientists and engineers wrote articles (frequently several articles) on the topics of their special competence. Finally, there were unknown numbers of clerks, copy editors, compositors, proofreaders, pressmen, and others involved in getting this mass of material into print and ready for distribution and use. With so much time, talent, and money devoted to the task, the result should be very good indeed.

It is. But it is much too big and comprehensive to be adequately reviewed by one person. I read a number of articles, some on familiar topics and some on fields I do not know, and I paid particular attention to the index. But this is not enough. So I asked for help, and secured the comments of a mathematician, a technical editor, a physicist, an ichthyologist (ichthyology, by the way, is not listed in the index), a reference librarian, the author of two of the encyclopedia articles, and one or two other generous helpers. The following comments are based on their examination of the volumes as well as my own. But even so, all we can claim is that we have sampled—we hope fairly—the great mass of material the encyclopedia makes available.

That the articles should vary in quality is inevitable, and nothing else

should be expected. The article on Boolean algebra, one consultant reports, is excellent ("I do not know of any other place where the graduate student or high school teacher could find a similar treatment") while the article on calculus is pedestrian and out of date. Another says, "I find much greater satisfaction with the general articles on biological principles and phenomena and on major groups of animals than I do with the articles about specific animals which are often very general, cursory notes."

Some articles are followed by a short list of references for further reading. Some lists include up-to-date references, and others include only textbooks and older citations. Publishers' names are omitted from references, and so are page citations.

In level of difficulty there is also variation. The publishers state that "Most of the articles, and at least the introductory parts of all of them, are within the comprehension of the college undergraduate in science or engineering, or of the especially interested high school student." The claim is generally justified, yet one consultant reports, "In some cases the reading level may even go beyond the first-year graduate student unless he is willing to look up references and really dig at it. In other cases the material could easily be read by a high school student or high school teacher." Another consultant, also a scientist, says, "some are beyond my depth."

There must have been a very large number of difficult decisions about the proper amount of space to devote to a particular topic. Some articles seem too brief; others give quite extended discussions. The following more or less random examples illustrate the range: 10 pages on alternating current circuit theory, 6 on quality control, 13 on radar, 25 (plus several other references) on radioactivity, 3 on reproduction in plants, 28 on reproduction in

animals, 3 on rice, 18 on sea water, $\frac{3}{4}$ on the Schmidt camera, $\frac{1}{2}$ on science, $2\frac{1}{4}$ on scientific methods, 2 on distilled spirits, and 14 lines on the screw jack.

What to include and what to exclude is always a problem. There are no index references to "scientists" or to biologists, physicists, earth scientists, or psychologists. Yet there is an item on Gestalt psychologists. Scientific organizations and agencies, such as the National Science Foundation, are in general not included, and neither are topics on scientific education, manpower, documentation, communication, and so forth.

The books are of reasonable size and weight, and easy to handle. The paper is of good quality, and the type legible. No sensible publisher would claim to produce 15 volumes without errors, and there are errors here. A mislabeled drawing, a misspelled name, an incomplete reference, and a few similar minor blemishes turned up in our examination of a number of articles. But the illustrations, usually line drawings but sometimes halftones, are quite adequate, and one can read a good while before running onto a typographical slip.

The key to an encyclopedia is its index. Volume 15 is entirely index. It gives, first, a list of the names of contributors (articles are signed by initials) so that one can identify the author of any article. Then follows an alphabetical list of contributors with the titles of the articles written by each. Finally there are 434 pages, four columns to the page, of subject index. Here it is that one goes to locate information on atomic weights, marine propellers, the rhinoceros, crystal defects, paleozoic floras, or any of nearly 10,000 other entries. Suppose one wants to find the table or list of the symbols used to identify the chemical elements, as one of my consultants did. The index lists "Symbols, chemical" and "Chemical symbols and formulas," but the article referred to in these two entries does not give the wanted information. Looking up "Chemical elements" provides a cross reference to "Elements (chemical)" under which there are 32 subheads, but symbols is not one of them. The information is, however, to be found in convenient form in the article on "Elements (chemical)." The joker in this situation is that the information is also available, although usually less conveniently, in over a hundred different places, for it is given in the article for each of the

individual chemical elements as well as in several other articles. Yet, not knowing this, and using the encyclopedia for the first time, it took considerable persistence on the part of an experienced technical editor to locate the information wanted.

Another example: the entry "earth resource patterns" is listed with 14 subheads, but before one comes to it there is the main heading "Earth" with 30 subheads and some cross references, then a series of items such as "earth (age of)" to "earth (origin of)," each with a number of subheads, and then another series starting with "earth-current measurements" in which, in proper alphabetical place, one comes upon "earth resource patterns." The secret here is that the index first lists items in which "earth" is used as a noun, for example, "earth (core of)," and then begins a new alphabetical sequence in which "earth" is an adjective, for example, "earth interior." Just why "earth (core of)" and "earth interior" were selected as index entries instead of "earth core" and "earth (interior of)" or why the same form was not used for both entries, I do not know. In any event, the unwary reader may well overlook an item in the index because of this arrangement of noun and adjectival usage. Whoever plans to use the encyclopedia to a considerable extent will undoubtedly learn how it was constructed; a first-time user, even an experienced librarian, may fail to find the desired entry even though it is there.

The principal use for an encyclopedia is to find information you don't already have. The *New Yorker* recently (24 December 1960) reported an interview with Harry S. Ashmore, the new editor of the *Encyclopaedia Britannica*, in which Mr. Ashmore quotes Robert Hutchins, chairman of the board of editors, as saying, "You assume that no brain surgeon will read its article on brain surgery to enable him to operate, but the article must be so well done that if he does read it some night, it won't offend him." By this criterion, most of the articles we examined were satisfactory. When we examined articles on topics strange to us, there were fewer criticisms. One consultant summarized: "In no such instance did I complete an article with the feeling of dissatisfaction. I felt that upon reading the article I had a much clearer notion of the specific topic," and then added, "It would be fine to have this encyclopedia in our

library and it could be recommended for home use as well. At least in my family, where there is a considerable interest in science, I found all members reading the volumes with interest and wishing that we might have them readily available."

DAEL WOLFLE

American Association for the Advancement of Science

China Crosses the Yalu. The decision to enter the Korean war. Allen S. Whiting. Macmillan, New York, 1960. x + 219 pp. \$7.50.

This book is of interest not only because of the importance of its subject but also because it shows the possibilities and limitations of any study of Chinese Communist foreign policy. At one point the author lists four main sources of evidence: official statements made for foreign consumption; a content analysis of the material intended for internal consumption, which appeared in the officially controlled Chinese press; U.S. intelligence reports and material obtained by interrogation of Chinese prisoners; and Peking's diplomatic activity, particularly toward India and the United Nations. Whiting argues: "None of these sources provides a comprehensive picture of decision making in Peking, nor is the evidence always subject to one exclusive interpretation. At some points the four types of data each support incompatible hypotheses. At important junctures, however, they suggest a pattern of policy clearly and consistently enough to constrict the range of reasonable explanation for Chinese Communist actions" (pages 52-53).

The weight of evidence is against any serious Chinese involvement in the start of the Korean war. Relations between Peking and Pyongyang do not seem to have been close. It was not until August 1950 that an ambassador from Peking presented his credentials at Pyongyang, and there is evidence of earlier disputes between the North Koreans and the Chinese Communist authorities in Manchuria, which were resolved only by Soviet mediation. The emphasis of Chinese Communist publicity was on the conquest of Taiwan and Tibet, and Chinese troop dispositions appeared to be primarily designed for these objectives. The only bits of contrary evidence are the return to North Korea of Korean troops from the

Chinese Communist forces and, beginning in April 1950, a movement of the Fourth Field Army from South China to Manchuria. However, the return of Korean troops to Korea can be explained as part of a general settlement mediated by the Soviet Union, and the movement of this particular army to Manchuria can be explained as part of a plan to return army units to their original base areas.

When the Korean war started comment in the Peking press was delayed for 2 days, and the comments which did appear in the early period of the war suggested that the Chinese Communist leaders did not wish to present the Korean conflict to their public as an issue of primary importance to China. On the other hand, the reaction to President Truman's order to the Seventh Fleet to neutralize Taiwan was immediate and violent.

This action by the United States seems to have ended plans for an attack on Taiwan in the near future, and there was a redeployment of Chinese forces from South and Central China, some to Manchuria and some to Shantung. But the Chinese Communists did not use the most favorable opportunity for intervention when the United Nations forces had been driven back to a small area around Pusan and a little extra support on the North Korean side might have put the Communists in complete control of Korea. The material from the interrogation of prisoners shows that even the forces in Manchuria received little preparation for intervention until shortly before they crossed the Korean border in October.

There is an interesting discussion of the complicated negotiations at the United Nations and of the evidence that the Soviet representative may have been looking for some way to reach a compromise before the U.N. counter-attack started. One point of special interest is the change in the Chinese attitude toward India. To begin with, Chinese comments had been strongly critical of Nehru's neutralism and had denounced him as a tool of the imperialists, but Indian support for Peking's admission to the U.N. and Indian proposals for a compromise in Korea gradually brought about a change in attitude.

No conclusive deductions can be made about the precise reasons which finally made the Chinese Communists decide to intervene in the Korean war. Soviet pressure for intervention to prevent a complete North Korean defeat

is suggested as a possible hypothesis, but while this does not conflict with the evidence, there is no positive evidence for it. Negatively, the line of Chinese publicity indicated that the Chinese Communist leaders were not much concerned over some of the points on which the U.N. side was willing to give them guarantees concerning Chinese interests, such as the question of power supplies for Manchuria from installations on the Yalu River. They were obviously much more moved by political considerations, even though it is not clear precisely which political considerations were decisive.

It is suggested that an important factor was a failure in communication. The Chinese Communist leaders appear to have considered that they had given clear warning that they would intervene if United Nations forces crossed the 38th parallel and to have failed to realize that their warnings had been given in a way, and in a context, which led many people not to take them seriously. Similarly, the United States authorities failed to realize the confusion caused in Peking by the statements of General MacArthur and other people in the American government organization. "Utterances by 'authoritative spokesmen' in Tokyo were given equal weight (if not greater) with statements from Secretary Acheson and President Truman" (page 169).

There are some points on which the reader might wish for fuller discussion. For instance, the Wu Hsiu-ch'uan delegation to the U.N. is mentioned, and there is some discussion of possible reasons for the delay of almost a month in accepting the U.N. invitation. But the circumstances leading to the invitation are not made clear, and there is no discussion of the behavior of the delegation. The reader is told that on 24 November "Wu Hsiu-ch'uan arrives in New York, confers with Lie" (page 147). But he is not told of Wu's refusal to take part in serious discussions, either with Lie or with British representatives who tried to contact him, although the issue has important relevance for the problem of communication. How does one communicate with people who refuse to join in discussion? More generally, the book might have been more valuable if it had covered a rather wider period including the truce negotiations where the same sources of evidence could probably have revealed a good deal more about Sino-Soviet relations; the initiative both in starting truce negotiations and in

changing the Communist position, which made possible a settlement of the prisoners-of-war dispute, seem to have come from the Soviet Union. However, while on some points the book might have told more, what it does tell is both interesting and important.

LINDSAY OF BIRKER
*School of International Service,
American University*

Le Sahara des Africains. Attilio Gaudio.
Julliard, Paris, 1960. 297 pp. Illus.
\$3.15 (approximately).

Attilio Gaudio seems to be a Man with a Message, the old and now tragically threadbare message of Utopia applied this time to the Sahara and North Africa in general. His latest book is essentially a human geography of the desert area which extends from the Atlantic to the Red Sea and from the mountainous and coastal desert fringes of the Mediterranean to approximately the latitude of Lake Chad.

Although sections dealing with the prehistoric and early historical periods make very entertaining reading, they are sadly incomplete and out of date, and they are weakened still further by dream-like revelations concerning tribal origins. The ethnographical descriptions of modern tribes are so fragmentary and uneven in quality as to be almost incoherent in some cases. There are so many errors as well as casually sweeping assumptions sprinkled through the book that it would be hopeless even to attempt to discuss them here. "Where there is sand there is water," says the author—if only he were right! And then he tells us that the water of the Nile often transmits "a terrible disease, bilharziasis . . . which no medicine can cure"—thank goodness he is wrong! And so on and so on. But there is some grain among the chaff.

Many pages are crammed with reasonably accurate figures concerning the natural resources and recent industrial development of the Sahara; these are really valuable, however boring they may be. And there are a few, a very few, strikingly bright spots here and there. Speaking of the reaction of a native guide to the Spanish and French methods of administering Moorish territory, Gaudio writes: "It all seemed unjust and absurd to this nomad, for whom, as for all his kind, the only real wealth is liberty [-anarchy], and the

only mother-country is the desert without frontiers." The destructive impact of industrial expansion on native sociopolitical and economic structures is described clearly and forcefully. A few casually incidental remarks mention recent fighting between joint Franco-Spanish and Moroccan forces (along the eastern frontiers of Morocco and the Spanish Sahara) which, so far as I know, has never before been referred to publicly, in either French or English. And yet even the practical value of Gaudio's book as a work of ready reference is seriously impaired because it has no index, no glossary, and no bibliography, and there are no precise bibliographical references in either the text or footnotes. There is a double-page map which looks excellent at first glance, but several of the places whose importance is stressed are not marked on it.

Gaudio's main argument is based on the astonishing proposition that the native peoples of the Sahara constitute a single spiritual whole, and so can easily become united (together with the peoples of Morocco, Algeria, and Tunisia) in a single stable confederation or nation, in which all will enjoy equal rights and privileges. From this he concludes that such a union is not only thoroughly desirable but eventually inevitable, in any case. Once established, this union's central government or federal council could invite foreign enterprise to develop the natural resources of the desert; the proceeds would be shared on a fifty-fifty basis, and everyone in the Sahara would then live happily forever after. I see no point in discussing this miraculous solution of all the current and awesomely complex problems of the Sahara and North Africa, beyond remarking that it seems to me utterly impossible, if only because of the essential disunity of the Saharan peoples. This disunity has been explained at length and in detail in several recent publications.

In short, *Le Sahara des Africains* is an incongruous mixture of solid fact and pseudoscientific theory, handled in a journalistic manner which sometimes verges on the sensational and sometimes sounds almost like straight political propaganda. Although the picture it presents of the Sahara purports to be well rounded, it is in fact deceptively incomplete and unbalanced, except in the field of economics, and even there the coverage is spotty. *Caveat lector.*

LLOYD CABOT BRIGGS
Peabody Museum, Harvard University

Higher Education in the United States: the Economic Problems. Seymour E. Harris, Ed. Harvard University Press, Cambridge, Mass., 1960. 252 pp. \$5.50.

This volume presents a series of papers and discussion summaries which were considered by the Seminar on Higher Education held at Harvard University during 1958-59. Necessarily the papers and the discussions have little continuity and some repetition. Taken together, the contents range broadly over both the academic and the financial problems confronting the country's colleges and universities.

Seymour Harris, who contributed the opening essay, has chosen to divide the contents of the volume into six categories: pricing and the student body, government aid, faculty status, experimental programs, economics and educational values, and investment policies. These major subjects of discussion should indicate that herein there is something for everyone concerned with higher education.

From a technical point of view, the investment officers and committees of colleges will find the section on endowment management useful. The issues discussed are not new, especially the problem of investment for income or capital appreciation, but they are clearly delineated.

In a volume edited by Harris, the matter of pricing higher education to the student is bound to receive a great deal of attention. Harris makes his own position clear at the outset: the student must pay more because government and philanthropy (including endowment income) will not be able or willing to provide the income needed by our colleges and universities. The papers and discussion on this subject helped to trigger a nationwide debate which has continued to the present and which will continue into the future. If for no other than historical reasons, this part of the book is most important.

The section on government aid is perhaps noteworthy primarily for what it does not discuss. Although the seminar's participants appear to favor both federal and state aid to privately sponsored colleges and universities, the religious issue seems to have escaped comment. But that issue alone may well prevent any new federal aid to institutions of higher education in 1961.

As an academic administrator I was especially aroused by Caplow's paper, "Faculty pay and institutional extrava-

gance." There is no doubt that, in relative terms, we spend more today on student personnel programs and even on institutional police or security than was spent 30 years ago. But growth in size is not the principal explanation; the insistence of faculty members upon devoting time primarily to the classroom and to their research has made new specialization inevitable in the academic community.

Perhaps the major bias in the volume is its sectional point of view. New England attitudes are clearly evident throughout.

Surely enough has been said, however, to suggest the breadth of issues taken up in this volume; these issues are of vital concern for all interested in higher education as a social institution.

JOHN D. MILLETT

Miami University, Oxford, Ohio

New Books

Biological and Medical Sciences

The Beetles of the United States. A manual for identification (Section 1). Ross H. Arnett. Catholic Univ. of America Press, Washington, D.C., 1960. 221 pp. Illus. Section 1. \$3.50; complete work, \$25; binder, \$3.95. The area covered is roughly the United States exclusive of Alaska and Hawaii, but parts of Canada and Mexico are also covered.

Blonemics, Systematics, and Phylogeny of Lytta, a Genus of Blister Beetles (Coleoptera, Meloidae). Biological Monogr. No. 28. Richard B. Selander. Univ. of Illinois Press, Urbana, 1960. 301 pp. Illus. Paper, \$4.50; cloth, \$5.50.

Biology of Pyelonephritis. Edward L. Quinn and Edward H. Kass, Eds. Little, Brown, Boston, Mass., 1960. 732 pp. Illus. \$18.

The Dispensary of the United States of America. vol. 2. New drug developments volume. Arthur Osol and Robertson Pratt. Lippincott, Philadelphia, Pa., 1960. 240 pp. Illus. \$9.

The Ecology of Algae. A symposium held at the Pymatuning Laboratory of Field Biology on 18-19 June 1959. C. A. Tryon, Jr., and R. T. Hartman. Pymatuning Laboratory of Field Biology, Univ. of Pittsburgh, Pittsburgh, Pa., 1960. 96 pp. **Encyclopedia of Plant Anatomy.** vol. 1, *Die Angiospermen*. Hermann Von Guttenberg. Borntraeger, Berlin, 1960. 322 pp.

Encyclopedia of Plant Physiology. vol. 5, pts. 1 and 2, *The Assimilation of Carbon Dioxide*. W. Ruhland, Ed. Springer, Berlin, 1960. 1013 pp.; 868 pp. Illus. DM. 530.

Functional Neuro-Anatomy. Including an atlas of the brain stem. A. R. Buchanan. Lea and Febiger, Philadelphia, Pa., ed. 4, 1961. 377 pp. Illus. \$8.50.

Fundamental Principles of Bacteriology. A. J. Salle. McGraw-Hill, New York, ed. 5, 1961. 822 pp. Illus. \$12.

Inhibition in the Nervous System and Gamma-Aminobutyric Acid. Edited by Eugene Roberts et al., Pergamon, New York, 1960. 591 pp. Illus. \$15.

An Introduction to Functional Histology. Geoffrey H. Bourne, Little, Brown, Boston, Mass., ed. 2, 1960. 271 pp. Illus. \$8.50.

Malaysian Parasites. Studies from the Institute for Medical Research, No. 29. W. W. Macdonald, Ed. Institute for Medical Research, Kuala Lumpur, Federation of Malaya, 1960. 251 pp. Illus. \$3.

Mammalian Hibernation. Bulletin of the Museum of Comparative Zoology, vol. 124, Charles P. Lyman and Albert R. Dawe, Eds. Museum of Comparative Zoology, Harvard Univ., Cambridge, Mass., 1960. 549 pp. Illus. Paper, \$3; cloth, \$4.50. The papers and discussion constitute the proceedings of the First International Symposium on Natural Mammalian Hibernation. The conference's 45 participants included researchers from the U.S. and from Canada, Finland, France, Germany, Russia, and Sweden. The first 2½ days were devoted to a series of 26 papers designed to bring together available knowledge in the field. On the last afternoon seven scientists who had attended the presentation of all the papers (with minor exceptions), but had not concentrated their own research in this precise field, discussed the problem as a whole. In the preface the editors say that anyone who reads this volume will realize that there are gaps in our knowledge and that much critical work remains to be done; it is hoped that this realization will spur interest in the field.

Mental Drugs. Chemistry's challenge to psychotherapy. O. A. Battista. Chilton, Philadelphia, Pa., 1960. 177 pp. \$3.95.

The Microscope. And how to use it. George Stehli. Sterling, New York, 1960. 160 pp. Illus. \$3.95. This volume, translated from the German, is "intended . . . as a methodical introduction" to the subject.

Mushrooms of the Great Smokies. A field guide to some mushrooms and their relatives. L. R. Hesler. Univ. of Tennessee Press, Knoxville, 1960. 301 pp. \$5.50.

Representative Chordates. A manual of comparative anatomy. Charles K. Weichert. McGraw-Hill, New York, ed. 2, 1961. 225 pp. Illus. \$4.25. This manual, designed for use as a laboratory manual, presents a comparative study of the marine lamprey (*Petromyzon marinus*), the spiny dogfish (*Squalus acanthias*), the mud puppy (*Necturus maculosus*), and the cat (*Felis domestica*).

Recent Advances in Pathology. C. V. Harrison, Ed. Little, Brown, Boston, Mass., ed. 7, 1960. 460 pp. Illus. \$11.

A Textbook of Histology. Functional significance of cells and intercellular substances. John C. Finerty and E. V. Cowdry. Lea and Febiger, Philadelphia, Pa., ed. 5, 1960. 573 pp. Illus.

Theoretical and Practical Problems of Medicine and Biology in Experiments on Monkeys. I. A. Utkin, Ed. Translated from the Russian by Ruth Schachter. Pergamon, New York, 1960. 283 pp. Illus. \$9.

Traité de Pisciculture. Marcel Huet. Wynngaert, Brussels, Belgium, ed. 3, 1960. 381 pp. Illus. Paper, \$7.50.

Reports

Intellectual Potential and Heredity

Abstract. When infant developmental quotients are compared with children's intelligence quotients, it appears that most subnormality is manifested only at the later age. This phenomenon has been cited as evidence that environment chiefly determines intelligence, but the argument is circular. A helpful approach to the nature-nurture problem is afforded by the geneticists' concept of reaction norms or "reaction repertoires."

In the AAAS Symposium of 1956, Knobloch and Pasamanick (1) reported studies on the distribution of developmental quotients in Baltimore infants. They found only 1.8 percent with quotients below 85, while approximately 14 percent of older children are known to have intelligence quotients in this range. They cite this alleged increase in subnormality as evidence for the operation of psychosocial as opposed to genetic factors. Finally, on the basis of their study "as well as others," they conclude that, "So heavily do these psychosocial factors seem to outweigh any genetic behavior variation that it seems extremely difficult to find any evidence for the importance or even the very existence of the latter" (1, p. 263).

My intention is not to challenge the conclusion of Knobloch and Pasamanick, though I shall disagree with it, but to show that the findings they report provide no more support for their conclusion than for an opposite one. Their conclusion remains a hypothesis for which their study yields no new evidence.

The essential difficulty is one of circular reasoning. While the circle appears at several points in the article, it

is best illustrated in the following two quotations, preceding and following what they regard as the crucial synthesis of evidence (italics mine):

"Let us turn now to a comparison of the present findings with the distributions of intelligence quotients of older children and adolescents as reported in the literature. While the intelligence quotient is influenced by more environmental factors than affect the intellectual potential as diagnosed in infancy, the IQ is obviously related to neural integration. *A lowered score may be the result of many environmental factors, physical, psychological and social,* but a higher score can only be the result of learning. A comparison of these two estimates, therefore, may help elucidate the question of how large is the influence of environmental factors on intelligence test scores" (1, p. 259).

"The observations which we have presented in this report would appear to us to lend support to the hypothesis that *the measures of intelligence used in later life are greatly influenced by learning and affected by life experiences which tend to limit opportunities of acquiring the kinds of information that the tests seek to evaluate*" (1, p. 261).

Note that what appears in the first quotation as an assumption upon which the argument is built, reappears in the second as a conclusion. Clearly, if one considers development to be controlled only by environmental influences, any developmental differences among individuals must be attributed to the environment. One could as well start with an alternate assumption, that intellectual development, except for its content, depends upon learning rate, learning capacity, and maturation of thought and behavior patterns. Then the increase in subnormality at later ages would appear to support a hypothesis that measures of intelligence used in later life reflect relevant genetic potentials more adequately than does the infant developmental quotient.

I will not dispute the plausibility of the authors' initial assumptions or the validity of their data, although comparability of developmental quotient and intelligence quotient scales is open to question (2). The data by themselves illustrate individual differences and suggest that infant behavior does not ex-

press all the determining factors for final intellectual functions. The point is that the findings contain no internal evidence as to the nature of these determining factors. It can be argued similarly, I think, that most of the other evidence referred to by the authors is as ambiguous as their own. When analyzed on the basis of restrictive assumptions, such data will yield restricted conclusions.

Any extreme view in the nature-nurture controversy appears to be unjustified at the present time. The most useful hypothesis is neither of those hypotheses of a generation ago that considered one or the other influence alone, but a hypothesis that assumes undetermined contributions from both.

The well-established genetic concept of the reaction norm (3), better described by the term "reaction repertoire" (4), is a useful framework in which to consider heredity-environment interactions. In the application of this concept to quantitative variates, a genotype determines not a limiting phenotype but an indefinite assortment of phenotypes each of which corresponds to certain possible environments. The relative probabilities depend on relative frequencies of different environments; the assortment of phenotypes or the repertoire of reactions and responses is characteristic of the genotype. Since the most probable phenotype of some genotypes may be an extreme or pathological character, these genotypes will produce normal individuals only in unusual environments, if at all. Thus, persons homozygous for phenylketonuria will have normal mentality only in the very rare environments that lack dietary phenylalanine. If a genotype determines an intelligence quotient around 120 in the commonest environments, some rare environments may restrict that individual's achievement to a score of 100 or lower, and others may raise it to 130 or 160. Another genotype in the same lifelong environments might respond entirely differently.

Under this view, the two traditionally conflicting approaches to heredity and environment can be restated in terms of separate and complementary problems:

(i) What are the differences between individual reaction repertoires?

(ii) How flexible is individual development and behavior, that is, how great is the phenotypic variance of individual genotypes?

These questions presuppose a rather well-defined array of environments, and with experimental organisms the approach to both problems is straightforward. For man and particularly for human mental traits, the array of environments cannot be adequately speci-

Instructions for preparing reports. Begin the report with an abstract of from 45 to 55 words. The abstract should not repeat phrases employed in the title. It should work with the title to give the reader a summary of the results presented in the report proper.

Type manuscripts double-spaced and submit one ribbon copy and one carbon copy.

Limit the report proper to the equivalent of 1200 words. This space includes that occupied by illustrative material as well as by the references and notes.

Limit illustrative material to one 2-column figure (that is, a figure whose width equals two columns of text) or to one 2-column table or to two 1-column illustrations, which may consist of two figures or two tables or one of each.

For further details see "Suggestions to Contributors" [Science 125, 16 (1957)].

fied; the two questions cannot be separately investigated, but they must nevertheless receive separate answers. Solutions will be reached only by a difficult and slow process of successive approximations.

GORDON ALLEN

National Institute of
Mental Health, Bethesda, Maryland

References

1. H. Knobloch and B. Pasamanick, in "Epidemiology of mental disorder," *Publ. Am. Assoc. Advanc. Sci.* No. 60, 249 (1959).
2. A. Anastasi, in *ibid.*, p. 264.
3. T. Dobzhansky, *Evolution, Genetics, and Man* (Wiley, New York, 1955).
4. See J. L. Fuller and W. R. Thompson, *Behavior Genetics* (Wiley, New York, 1960), p. 91.

10 October 1960

In the paper (1) criticized by Gordon Allen, we used data from a longitudinal study of a thousand Baltimore infants to speculate upon the major sources of variation in intelligence to be anticipated in them in later life. Only 1.8 percent of this stratified sample, when adjusted for the stratification variables to the Baltimore population, had quotients below 85, in contrast to the 14 percent which might be expected during school age. We also indicated further environmental sources of variability as a result of the largely socio-economically associated prenatal damage following complications of pregnancy as well as prematurity. Allen does not point out that a 30 percent sample of this cohort was reexamined at 3 years of age. The average score for the white infants rose to above 110, while that for the Negroes fell to below 100. In the 4 years since the reading of this paper we have published the findings of additional studies in this area (2). One point pertinent to the matter under discussion is that at 3 years of age there was an increased percentage of low scores; it lay between the 1.8 percent found in the infants and the 14 percent found in school-age children. As was predicted, it occurred almost wholly in the Negro and lower-class white portions of the population.

Comparisons of distributions were possible because of the demonstration of a highly significant correlation between performances in infants and 3-year-olds, reaching 0.75 in those children with the lower scores under discussion. Anne Anastasi, one of the foremost experts in child development and differential psychology, did not question the comparability of developmental quotient and intelligence quotient scales, as Allen implies. In her discussion (3) of the paper she asked for some points of information which we felt were adequately supplied in the succeeding response [(1), p. 269].

We prefer to avoid debate of Allen's

contention that our findings present "no new evidence." Dr. Anastasi opened her discussion [(1), p. 264] by stating, "As a psychologist, I cannot help but be impressed with the importance of the research we have just heard reported and with its far-reaching implications. With regard to the heredity-environment problem, the chief value of such a study lies in its bringing us a step closer to answering the question, 'How?' By tracing relationships between socio-economic factors, prematurity, neurological damage, and subsequent behavioral development, such an investigation helps to disentangle the chain of events leading up to individual differences in intellectual functioning."

Our paper was presented to a sophisticated audience and it was unnecessary, except bibliographically, to refer them to the enormous collection of data on the nature and nurture controversy of this century (4). The English canal boat children findings, the Isle of Man study, Klineberg's work on racial differences, and the Army experiences with both white and Negro illiterates on intelligence tests are not "ambiguous." These studies are not definitive, but they all point in one direction and indicate the importance of environmental factors in determining intelligence test responses. New bits of information which are crucial signposts along the same path appear constantly. One of the most recent of these which is pertinent to the paper under discussion is the observation that within a few years' time prematurity rates in some of the Scandinavian countries have been reduced to 3 percent. This was effected largely by changes in prenatal care. This rapid reduction would seem to indicate that environmental rather than genetic factors are etiologic in prematurity, which is so highly associated with mental defect and poor intellectual performance.

We would like to point out that in the process of comparing infant examination findings with the performance on tests of intelligence later in life by the same individuals, we have in large measure removed the environmentally determined "content" as a contaminating and confounding variable which occurs even in so-called "culture-free" tests of intelligence. It is this point which Allen apparently fails to comprehend when he suggests "that measures of intelligence used in later life reflect relevant genetic potentials more adequately."

A common misunderstanding of scientific strategy is the concept that, if an alternative explanation is possible, it is necessarily equally good. The choice of the most acceptable hypothesis obviously must rest upon such considerations as scientific parsimony,

the weight of the evidence, and fruitfulness for further investigation. This is particularly true in the area of variations in human intelligence where the definitive studies are obviously impossible at this time. Elucidation of the specific enzymatic nature of the genes involved, breeding studies, or even control of the crucial environmental variables do not appear likely in the immediate future. This does not mean that hypotheses cannot be advanced and even partially tested by means of longitudinal investigations. Such studies comprise the process of successive approximations required by the very nature of epidemiologic investigations. Elsewhere we have proposed studies which can more definitively test the hypotheses we advanced (5).

We have no quarrel with Dobzhansky's concept of the "reaction repertoire." Indeed, it is implicit in our theoretical substrate when we stated "the genetic constitution gives man his distinctly human character, and neurologic integrity is basic to the realization of his full developmental potential. In the human organism with an undamaged central nervous system, however, it is life experiences rather than hereditary influences which seem more important in molding intellectual functioning" [(1), p. 250]. It was by studies similar to ours that the first narrowly rigid genetic conceptualizations were altered. We believe that our data have in fact shed some light on the question raised by Allen of "how flexible is individual development and behavior." Parenthetically, the example chosen by him as an illustration of the "reaction repertoire" is rather unfortunate, since the reported number of apparently homozygous phenylketonurics with normal mentality increases yearly (6).

It merely remains to discuss Allen's opening comments on some alleged circular reasoning. Both paragraphs he used were taken out of context from the discussion section at the end of the paper. The second paragraph refers to a hypothesis and not a "conclusion"; it is quite subsidiary to the chief hypothesis of the study. It is also somewhat irrelevant, since we were not primarily concerned with testing variables affecting "measures of intelligence." We merely indicated that the data lent some support to the concept that those measures used in later life are greatly influenced by learning and, in Allen's terms, help determine the "content" of "intellectual development." In the first paragraph Allen chose to look only at the generalization and did not relate the statements on "the lowered score" to the children we reexamined at 3 years of age.

We would like to reiterate the statement made at the conclusion of our

paper. "Even though there are lacunae in the evidence, the patterning of almost all the recent studies, ours as well as others, points the total picture overwhelmingly in one direction. The geneticists will need to give more than *post hoc* data and will require experimental or better controlled epidemiological studies than have previously been offered to support their views. Otherwise, scientific parsimony seems to lead one to the conclusion that at the present time the most useful theory is that while man's fundamental structure and consequently his basic functioning is genetically determined, it is his socio-cultural milieu affecting biological and psychological variables which modifies his behavior and, in the absence of organic brain damage, makes one individual significantly different from the next" [(1), p. 263].

HILDA KNOBLOCH

Ohio State University and
Clinic of Child Development,
Children's Hospital, Columbus

BENJAMIN PASAMANICK

Ohio State University and
Columbus Psychiatric Institute
and Hospital, Columbus

References

1. H. Knobloch and B. Pasamanick, in "Epidemiology of mental disorder," Publ. Am. Assoc. Advance. Sci. No. 60, 249 (1959).
2. —, *Pediatrics* 26, 210 (1960).
3. A. Anastasi, see (1), p. 266.
4. *Yearbook Natl. Soc. Stud. Educ.* 27 (1928); 39 (1940).
5. B. Pasamanick, *Am. J. Mental Deficiency* 64, 316 (1959).
6. B. S. Sutherland, H. K. Berry, H. C. Shirkey, *J. Pediatr.* 57, 521 (1960).

27 December 1960

Calcite in *Lesquerella ovalifolia* Rydb.

Abstract. By chemical analysis, trichomes of *Lesquerella ovalifolia* Rydb. have been shown to contain a high percentage of calcium carbonate. X-ray diffraction patterns showed that it was in the form of calcite. The calcite was inside the trichomes, and its depositional pattern conformed to the shape of the trichomes. A small amount of opal was present in the trichomes.

Recently a photograph of trichomes of *Lesquerella ovalifolia* Rydb. appeared on the cover of *Science* (1); they were reported to be highly refractive. The present investigation was begun to see whether or not the refractivity might be due to the presence of silica.

The plants used in these experiments grew in Scott County, Kansas, on steep rocky slopes with limestone outcroppings. The trichomes were scraped from the leaves with a razor blade and dried in an oven at 110°C. Part of the tri-



Fig. 1. Spodogram showing calcite deposition in *Lesquerella ovalifolia* Rydb. trichomes (about $\times 53$).

chomes were ashed at 500° to 600° and silica was determined by standard gravimetric techniques. The silicon dioxide content was determined by difference of weights before and after treatment with hydrofluoric acid.

Calcium was determined on another ashed sample by the standard A.O.A.C. method with a Beckman model DU flame spectrophotometer and a Sargent recorder. Carbon dioxide was determined by using the standard gas-evolution method directly on oven-dried, powdered trichomes. X-ray diffraction patterns were made for both powdered trichomes and the ash of trichomes on a North American Phillips diffractometer with nickel-filtered copper radiation obtained with a current setting of 20 ma at 40 kv.

Petrographic microscope studies were made on the silica obtained by ashing trichomes and treating the ash with hydrochloric acid. Trichomes were also examined directly with the petrographic microscope.

The depositional pattern of the carbonate was determined by making a spodogram. The spodogram process was developed by Uber (2), modified by Ponnaiya (3), and used by Lanning *et al.* (4) for determining silica depositional patterns in plants.

The results showed that the trichomes made up 51.7 percent of the leaves and that the trichomes were 30.8 percent ash. Chemical analysis showed that the trichomes contain 0.492 percent silicon dioxide, 10.8 percent calcium, and 12.23 percent carbon dioxide. Petrographic microscope examination of the silica showed it to be part plant opal and part detrital quartz. The calcium and carbon dioxide values indicated that the trichomes were 27.0 percent calcium carbonate and that the ash was 87.7 percent calcium carbonate. Trichomes of plants from Sheridan County State Park in Kansas contained 11.1 percent calcium.

High values for plants from two different areas indicate that high deposition of calcium carbonate in the trichomes is a characteristic of the species. The values also indicate an exceptional differential accumulation of calcium, for the leaves without trichomes contained only 2.25 percent calcium. The latter value is about average for leaves of many of the Cruciferae (5).

Calcium compounds are commonly deposited in phloem tissue and veins of plants (6), often in the form of the oxalate, pectate, or carbonate. In 1932 hackberry seed was reported to contain a very high percentage of calcium (7). In 1959 Swineford and Franks (8) found hackberry seed to contain 45.51 percent calcium carbonate in the form of aragonite.

The x-ray diffraction pattern of the ash showed the sharp peaks characteristic of calcite (9). No other sharp peaks were observed, indicating that the ash was largely calcium carbonate in the form of calcite. The x-ray diffraction pattern of the powdered trichomes also showed the calcite peaks. In addition it showed x-ray peaks of cellulose and small quartz peaks (detrital).

A spodogram of the trichomes (Fig. 1) shows that the depositional pattern of calcite is just like that of the trichomes. Microscopic examination showed that the calcium carbonate was inside the trichome and surrounded by organic matter of the cell wall. Some plant opal was also observed (10).

As far as I am aware, this is a first report of calcite in *Lesquerella ovalifolia* and in the genus. It also appears to be a first report of high calcium carbonate deposition in trichomes.

F. C. LANNING

Department of Chemistry, Kansas
State University, Manhattan

References and Notes

1. R. C. Rollins, *Science* 131, 683, 687 (1960).
2. F. M. Uber, *Botan. Rev.* 6, 204 (1940).
3. B. W. X. Ponnaiya, "Studies in the genus *Sorghum*: the cause of resistance in sorghum to the insect pest *Antherigona indica* M.," *J. Madras Univ.* B21, No. 2 (1951).
4. F. C. Lanning, B. W. X. Ponnaiya, C. F. Crumpton, *Plant Physiol.* 33, 339 (1958).
5. K. C. Beeson, "The mineral composition of crops with particular reference to the soils in which they were grown," *U.S. Dept. of Agriculture Misc. Publ. No. 369* (1941).
6. B. S. Meyer and D. B. Anderson, *Plant Physiology* (Van Nostrand, New York, ed. 2, 1952), p. 480.
7. E. Yanovsky, E. K. Nelson, R. M. Kingsbury, *Science* 75, 564 (1932).
8. A. Swineford and P. C. Franks, "Opal in the Ogallala formation in Kansas. Silica in sediments," *Soc. Econ. Paleontologists and Mineralogists Special Publ. No. 7* (1959).
9. H. E. Swanson and R. K. Fuyat, *Natl. Bur. Standards (U.S.) Circ. No. 539* (1953), p. 51.
10. The investigation was supported by National Science Foundation grant No. NSF67 7101. I wish to express my gratitude to Carl F. Crumpton for making the x-ray diffraction patterns and to Dr. L. C. Hulbert for furnishing the *Lesquerella ovalifolia* plants.

12 December 1960

Incorporation of Heterologous Deoxyribonucleic Acid into Mammalian Cells

Abstract. Particles containing large molecular heterologous deoxyribonucleic acid have been incorporated into strain L cells in suspension tissue culture. The particles are Feulgen-positive, they are fluorescent under ultraviolet light when stained with acridine orange, and they appear in both the nucleus and cytoplasm in radioautographic preparations.

The phenomenon of transformation in bacteria is well established (1). At the present time there is no definite evidence of transformation in mammalian cells. The recent work with purified deoxyribose nucleic acid of polyoma virus may be an example of this phenomenon, although it remains to be proved whether viral nucleic acid is incorporated into the genetic apparatus of cells or whether it merely acts as a stimulus to cell division (2). The incorporation of labeled nucleic acid into cells has been reported by several investigators (3). In all of these experiments it has remained uncertain whether degradation occurred at the cell membrane and whether the label really represented intact nucleic acid or nucleotides and simple base components.

Previous work in this laboratory has shown that strain L cells grown in suspension tissue culture are able to phagocytize large particles and continue to divide in logarithmic growth (4). We have found that soluble deoxyribonucleic acid (DNA) does not enter these cells in appreciable amounts under these conditions. Therefore, we have incorporated particles containing high molecular DNA and protein into cells by phagocytosis. Initial attempts at particle formation involved the adsorption of nucleic acids onto resin and activated charcoal particles. Eventually, a system of particle formation by coacervation of protein and nucleic acid was devised, as follows: DNA was extracted from a variety of bacterial and mammalian cells by the salt extraction method of Zamenhof (5), the chloroform method of Hotchkiss (6), and the phenol method of Kirby (7). Dilute aqueous solutions of DNA (0.5 to 10 mg/ml) were coacervated by the addition of an equal volume of a gelatin solution (0.25 to 1 percent) after adjustment of the pH to 3 to 4 in a water bath at 50°C. The size of the resulting individual particles depends on the concentration of both the DNA and the gelatin and may vary between 0.5 and 50 μ . The progressive increase in the size of the particles with continued incubation in the water bath may be inhibited by denaturation or fixation of the protein component. Preparations

used in these experiments were fixed by the addition of a small amount of a 2.5 percent solution of glutaraldehyde. The particles were dialyzed for 48 hours against distilled water to remove the excess glutaraldehyde, and thereafter they could be stored indefinitely at 4°C (8). The protein, determined by the phenol reagent (9), measured 88 percent, and DNA, determined by the indole method (10), measured 12 percent.

The DNA particles (0.5 ml concentrated by centrifugation) were incubated with 13 ml of strain L cells (5×10^5 cells per milliliter) in a 50-ml erlenmeyer

flask on a rotary shaker at 37.5°C for 2 hours. The cells were then washed free of particles and grown as monolayers on cover slips in Leighton tissue-culture tubes. The cover slips were removed at intervals and stained with Feulgen's stain for DNA. In Fig. 1 (top left) Feulgen-positive particles may be clearly seen, distributed throughout the cytoplasm.

In other experiments, DNA was extracted by the phenol method and bound to acridine orange by incubation, for 5 minutes at 23°C, of the dye (20 μ g/ml) and the nucleic acid (200 mg/100 ml).

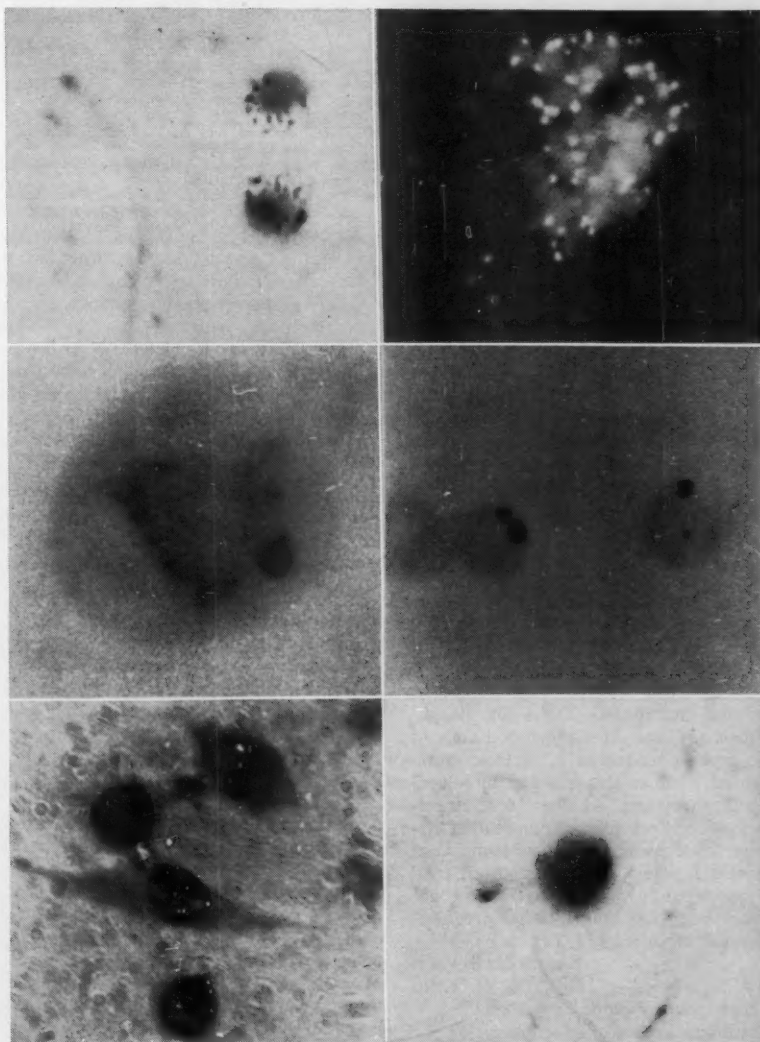


Fig. 1. The incorporation of heterologous DNA-protein particles into the nucleus and cytoplasm of strain L cells by phagocytosis (about $\times 508$). (Top left) Feulgen-positive particles appearing in cytoplasm. (Top right) Radioautograph of a centrifuged clump of DNA-protein particles. (Middle, left and right) Particles of DNA and protein previously complexed with acridine orange, as shown by fluorescence microscopy. (Bottom, left and right) Radioautographs of cells grown on cover slips, with particles in the cytoplasm and nucleus, as shown by light- and dark-phase microscopy after staining with Kernechtrot.

Particles were subsequently made by coacervation with gelatin. Examination of cells by fluorescence microscopy showed the presence of DNA particles in the cytoplasm (Fig. 1, middle).

Since the nuclear DNA obscured the possible presence of particles in the nucleus when the cells were examined after staining with both Feulgen and acridine orange, a third method of following particles was devised. A mouse with sarcoma 180 in the ascitic form was inoculated with tritiated thymidine (total, 1.4×10^6 count/min; specific activity, 1.9 c/mmole). After 2 hours the cells were removed from the peritoneal cavity and carefully washed free of extracellular thymidine, and the DNA was extracted by the phenol method. Dialyzed particles (0.5 ml, with a total of 30,000 count/min), prepared by coacervation of protein and DNA labeled with tritiated thymidine, were incubated with the cells, as described above, in the presence of unlabeled thymidine (10 mg/100 ml). This relatively enormous concentration of thymidine was considered sufficient to act as a metabolic trap which would prevent any labeled thymidine, released as a result of membrane degradation of the large nucleic acid molecule, from reaching either the cytoplasm or nucleus. The cells were fixed in a solution of acetic acid and alcohol (1:3) and NTB₃ emulsion used in the preparation of radioautographs. Radioautographs showed the presence of many particles over both the nucleus and cytoplasm (Fig. 1, bottom).

It is generally accepted that when cells are grown in a spread fashion on cover slips, the amount of cytoplasm overlying the nucleus is too thin to contain particles or detectable quantities of labeled thymidine.

It has been reported that fibroblasts in vivo incorporate DNA by phagocytosis (11), as do white blood cells in the lupus phenomena (12). Determination of whether this has any biological significance and whether true transformation is possible in mammalian systems must await the development of genetic markers similar to those used so successfully with bacteria. An abstract describing our work has previously been published (13, 14).

KLAUS G. BENSCH
DONALD W. KING

Department of Pathology, Yale
University School of Medicine,
New Haven, Connecticut

References and Notes

1. R. D. Hotchkiss, in *A Symposium on the Chemical Basis of Heredity*, W. D. McElroy and B. Glass, Eds. (Johns Hopkins Press, Baltimore, 1957), p. 321.
2. G. A. diMayorca, B. E. Eddy, S. E. Stewart, W. S. Hunter, C. Friend, A. Bendich, *Proc. Natl. Acad. Sci. U.S.A.* **45**, 1805 (1959).

3. M. R. Chorazy, H. H. Baldwin, R. D. Boutwell, *Federation Proc.* **19**, 307 (1960); A. Marshak, *Lab. Invest.* **8**, 460 (1959); S. M. Gartler, *Nature* **184**, 1505 (1959); F. M. Sirotnak and D. J. Hutchison, *Biochim. et Biophys. Acta* **36**, 246 (1959); E. Borenfreund, H. S. Rosenkranz, A. Bendich, *J. Mol. Biol.* **1**, 195 (1959); S. M. Gartler, *Biochem. Biophys. Research Commun.* **3**, 127 (1960).
4. K. G. Bensch, S. Simbonis, R. B. Hill, Jr., D. W. King, *Nature* **183**, 476 (1959).
5. S. Zamenhof, in *Methods in Enzymology*, S. P. Colowick and N. O. Kaplan, Eds. (Academic Press, New York, 1957), vol. 3, p. 696.
6. R. D. Hotchkiss, *ibid.*, p. 692.
7. K. S. Kirby, *Biochim. et Biophys. Acta* **36**, 117 (1959).
8. H. G. de Jong Bungenberg, in *Colloid Science*, A. E. Alexander and P. Johnson, Eds. (Elsevier, Amsterdam, 1949), vol. 2, p. 234; we are indebted to Dr. B. K. Green and Dr. Bernard Katchen of the National Cash Register Co. for their interest and advice in the preparation of the capsules.
9. V. I. Ogawa and H. Eagle, *Proc. Soc. Exptl. Biol. Med.* **91**, 305 (1956).
10. G. Ceriotti, *J. Biol. Chem.* **198**, 297 (1952).
11. R. D. Higginbotham, *Federation Proc.* **17**, 516 (1958).
12. G. C. Godman and A. D. Deitch, *J. Exptl. Med.* **106**, 575 (1957).
13. D. W. King and K. G. Bensch, *Federation Proc.* **19**, 308 (1960).
14. The work discussed in this report was supported by grant No. C2928 (C3) from the U.S. Public Health Service and the Jane Coffin Childs Memorial Fund.

19 September 1960

Time-out from Positive Reinforcement

Abstract. When an organism can itself impose extinction during fixed-ratio food reinforcement, the duration of the extinction period is a function of the number of responses required for reinforcement. Typically, the subject imposes extinction at the start of the usual fixed-ratio run.

When a response is reinforced, or rewarded, in the presence of a given stimulus, then that stimulus becomes the occasion for more responses. Another stimulus, in the presence of which no reward is obtainable, may be used as a sort of "time-out" condition. It has been shown that time-out can function either to reward or to punish behavior (1). Typically, the time-out condition has been introduced at infrequent intervals and for fixed durations. The subject's tendency to initiate or prolong a period of time-out has not been continuously measured. To overcome this limitation, a procedure has been devised in which the organism may initiate, or terminate, a period of time-out at any time. The procedure makes it possible to discover when an organism will initiate a time-out period and how long it will allow the time-out to continue, as functions of the underlying schedule of reinforcement.

A pigeon, at 80 percent of the weight it maintains when allowed to feed freely, is conditioned to peck a plastic disk through reinforcement with food im-

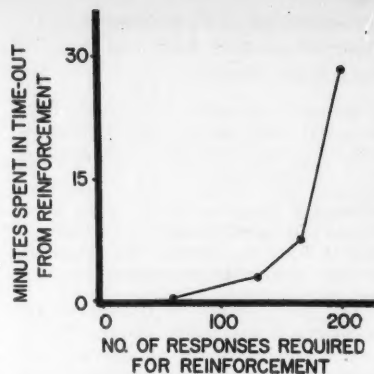


Fig. 1. Self-imposed periods of extinction as a function of the number of responses required during fixed-ratio reinforcement.

mediately after each peck. Food is then delivered only after every 50 responses—a so-called fixed-ratio schedule of reinforcement. Simultaneously, a second key, the time-out key, is made continuously available to the subject. A single response on this key changes the color and intensity of the ambient illumination, as well as of the light projected on the two translucent response keys. Under the changed illumination, all responses on the food key are ineffective in producing food. As a result, responding on the food key soon drops to zero. However, a second response on the time-out key restores the original conditions of illumination as well as the possibility of reinforcement. Thus, the organism is free at any time to terminate or to restore the stimulus situation which has been differentially associated with positive re-

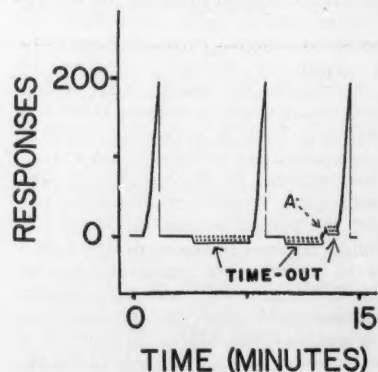


Fig. 2. Cumulative record of responses on a schedule of food reinforcement for every 200th response. The vertical reset line indicates the delivery of the reinforcement. Initiation of extinction is indicated by the downward deflection of the recording pen, and period of extinction, by the dotted area.

inforcement. The procedure may be designated control of extinction (the condition in which reinforcement is not obtainable) by the organism.

Four subjects have given similar results, indicating that the time spent under conditions of extinction is a function of the number of responses required to produce the food reinforcement. Figure 1 shows this relationship for one subject for which the number of responses required per reinforcement was increased from 65 to 200, in daily sessions of 60 minutes each. At low ratios, only a few seconds were spent in time-out. As the ratio was raised, the subject extended the time-out condition for longer periods. At a ratio requirement of 200 responses, the subject spent about 50 percent of the experimental period in time-out. Each point in Fig. 2 is an average for 5 days, but performance was often allowed to stabilize for several weeks.

Figure 2 presents a typical segment of a cumulative response record for one subject. The pattern of responding seen here is characteristic of fixed-ratio food reinforcement: a high rate prevails prior to reinforcement (top of each segment), and a long pause follows before another rapid run begins. The self-imposed periods of time-out are shown as a downward deflection of the recording pen (dotted areas). These occur typically during the long pause preceding the run. Occasionally there is a trickle of responses (as at A) before the subject initiates time-out. Once responding is well under way, however, time-out is not produced again until after reinforcement. Time-out is not initiated during the pause immediately following delivery of the food. Thus, time-out is not exclusively associated with lack of responding. Rather, the subject appears to initiate time-out just before making the number of responses required by the schedule.

Why should the pigeon impose a period of extinction upon itself? Accidental contingencies can be ruled out, since responses on the time-out key could not be indirectly reinforced by food, a standard period of several seconds having been interposed between any time-out response and food reinforcement. The change in stimuli was not itself reinforcing, since the pigeon imposed extinction periods regardless of whether an increase or a decrease in illumination was associated with time-out. A plausible explanation is that performance under a schedule of positive reinforcement may at certain stages be aversive in spite of the apparent absence of aversive stimuli (2).

N. H. AZRIN

Anna State Hospital,
Anna, Illinois

References and Notes

1. R. J. Herrnstein, thesis, Harvard University (1955); C. B. Ferster, *Science* 126, 509 (1957).
2. This investigation was supported by a grant from the Psychiatric Training and Research Fund of the Illinois Department of Public Welfare. Invaluable assistance and advice were provided by W. C. Holz.

20 October 1960

Effect of Psychotropic Drugs on the Uptake of H³-Norepinephrine by Tissues

Abstract. Reserpine, amphetamine, imipramine, and chlorpromazine markedly reduced the uptake of circulating H³-norepinephrine by several tissues and elevated the plasma concentration of the H³-catecholamine.

Many drugs affect the physiological actions of catecholamines, but little is known about their mode of action at a biochemical level. Previous work has shown that the psychotropic drugs reserpine, amphetamine, imipramine, and chlorpromazine increase the rate of disappearance of administered epinephrine and norepinephrine in the body (1). These observations prompted a study on the effect of these drugs on the uptake and metabolism of circulating catecholamine hormones in tissues.

Adult male cats, prepared as described previously (2), were given 25 μ g of H³-norepinephrine per kilogram (3.44 mc/mg) intravenously. Blood samples were taken periodically and the animals were decapitated 1 hour

after the end of the injection. The heart, spleen, adrenal glands, liver, and abdominal wall muscle were immediately removed and assayed for H³-norepinephrine and its major metabolic product H³-normetanephrine (2). Drugs were given before the administration of H³-norepinephrine as follows: Reserpine, 3 mg/kg intraperitoneally, 24 and 2 hours; amphetamine, 10 mg/kg, intravenously, 10 minutes; imipramine, 20 mg/kg, intraperitoneally, 3 hours and 1 hour; chlorpromazine, 20 mg/kg, intraperitoneally, 24 hours and 1 hour, and 5 mg/kg, intravenously, 20 minutes. Each drug was given to three cats; seven untreated cats served as controls.

The effect of psychotropic drugs on the tissue concentrations of H³-norepinephrine is shown in Fig. 1. In those organs where the concentration of administered norepinephrine has been shown to be greatest (heart, spleen, and adrenal gland), treatment with reserpine, amphetamine, imipramine and chlorpromazine caused a profound reduction in the tissue levels of the administered hormone. The concentration of H³-norepinephrine was reduced in the liver to a lesser extent while the catecholamine levels in the skeletal muscle were unaffected. H³-normetanephrine concentrations were reduced by one half in heart and spleen after treatment with reserpine, amphetamine, imipramine, and chlorpromazine, but these drugs had little or no effect on the level of the metabolite in other tissues.

Previous treatment with psycho-

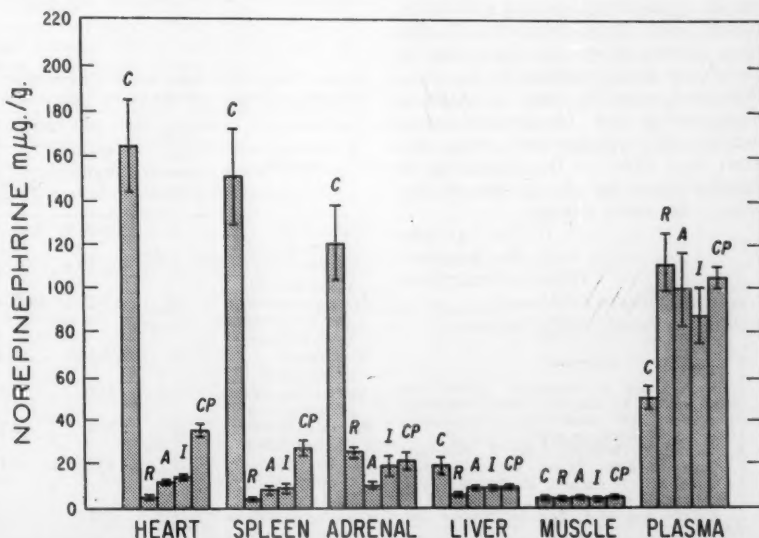


Fig. 1. Effect of psychotropic drugs on the tissue concentration of H³-norepinephrine. The following drugs were used: reserpine (R), amphetamine (A), imipramine (I), chlorpromazine (CP), untreated animals (C). The vertical bracketed lines represent the standard error of the mean.

tropic drugs also resulted in a considerable elevation in the plasma levels of H^+ -norepinephrine for the first 5 minutes after the injection of the hormone. Fig. 1 includes the plasma concentrations of the hormone after 2 minutes. No significant differences in the plasma concentration of the catecholamine in the control and drug-treated groups were found after 5 minutes.

Other psychotropic drugs such as sodium pentobarbital and J-B 516, a monoamine oxidase inhibitor, had no effect on the tissue and plasma concentration of norepinephrine. The monoamine oxidase inhibitor, however, raised the tissue and plasma levels of H^+ -nor-metanephrine.

The psychotropic drugs might reduce the tissue levels of noradrenaline by speeding its passage across membranes to the site of intracellular transformation, by increasing the rate of enzymatic destruction, or by interfering with its binding. If the transfer of norepinephrine across cell membrane were to be enhanced, plasma as well as tissue concentrations of the hormone would be reduced. In connection with the second proposal, it is unlikely that these drugs act by increasing enzymatic destruction since we have found that they do not activate catechol-O-methyl transferase, the enzyme primarily concerned with the metabolism of circulating catecholamines (3). However, it is possible that these drugs are producing their effects of catecholamine metabolism by influencing the binding mechanism. Interference with binding would affect the uptake of circulating norepinephrine and consequently lower the tissue concentration and elevate the plasma levels of the catecholamine. We have recently shown that the uptake of circulating norepinephrine by tissues is dependent upon the intact sympathetic nerve endings (4). The present finding indicates that psychotropic drugs may exert their effect on the disposition of catecholamines by altering the binding sites at the nerve endings.

JULIUS AXELROD
L. G. WHITBY*

GEORGE HERTTING†

National Institute of Mental
Health, Bethesda, Maryland

References

1. J. Axelrod and R. Tomchick, *Nature* **184**, 2027 (1959); J. Axelrod, *Ciba Foundation Symposium on Adrenergic Mechanisms* (Churchill, London, in press).
2. J. Axelrod, H. Weil-Malherbe, R. Tomchick, *J. Pharmacol. Exptl. Therap.* **127**, 251 (1959); L. G. Whitby, J. Axelrod, H. Weil-Malherbe, *J. Pharmacol. Exptl. Therap.*, in press.
3. J. Axelrod and M.-J. Laroche, *Science* **130**, 800 (1959).
4. G. Hertting, J. Axelrod, I. J. Kopin, L. G. Whitby, *Nature* **189**, 66 (1961).

* Fellow of the Rockefeller Foundation
† Visiting Scientist

21 September 1960

Evaporative Water Loss of Small Vertebrates, as Measured with an Infrared Analyzer

Abstract. Evaporation is linearly and inversely related to absolute humidity at 26° to 27°C. The relative rate of loss in desert reptiles, rodents, and anurans is about 1:10:40. The maximum rate of water loss is about 2.5 and 5 times the basal rate, respectively, in pocket mice and sand lizards. The ratio of loss from lung to loss from skin is about 84:16 in kangaroo rats and 70:30 in rattlesnakes.

Although evaporative water loss is an important item in the water balance of vertebrates, it has been difficult to measure directly under biologically meaningful conditions. Direct measurements made to date on small mammals (1, 2) and lizards (3) are of limited value because they involve exposure of the animals to dry air, an unusual biological condition. Almost all measurements on larger mammals (4) have been made indirectly.

The modern infrared gas analyzer provides a means of easily making accurate measurements of evaporative water loss over a complete range of ambient humidities. Prototype analyzers were used to study insensible water loss in human beings (5). The recent work of Decker (6), who used an infrared analyzer to study plant transpiration, was the stimulus for the work reported here (7).

In the method discussed here, animals that had been without food 12 to 24 hours were individually placed within a cylindrical glass chamber of 400-ml volume, and air of controlled humidity was drawn through the cham-

ber and then through a Beckman 15A infrared analyzer. Air could also be drawn directly through the analyzer via a by-pass. It was thus possible to change quickly from monitoring the water content of the air leaving the chamber to monitoring the content of the air entering it.

Constant, known humidities were obtained by passing room air through drying tubes of Anhydron, or by bubbling it through saturated potassium acetate solution, saturated sodium acetate, or distilled water, kept at 20.0° ± 0.1°C. The humidities thus obtained, for animal-chamber temperatures of 26° to 27°C, were 0.0, 3.3, 10.0, and 12.3 mg of water, respectively, per liter of air (15.6 mg/lit. = saturation).

When recording over the humidity range of 0.0 to 15.0 mg/lit., with an air flow of 423 ml/min, it was possible to measure water-vapor loss to ± 0.04 mg/min. For animals that had a rate of loss near this value, measurements were made by sealing the animal in the chamber without air flow for 15 to 30 minutes and then flushing out and recording the amount of water vapor accumulated. The responsiveness of the instrument is such that the water expired with individual breaths of slow-breathing vertebrates, such as rattlesnakes, can be recorded. Recording was continued at a particular humidity until a minimum rate of loss was maintained for 15 to 30 minutes while the animal was sleeping (mammals) or remaining quiet (others).

Some measurements were made with animals that had been deliberately excited. Other measurements were made

Table 1. Evaporative water loss of a series of small vertebrates, measured at 26° to 27°C and at four different absolute humidities (in milligrams of water per liter of air).

Species	Measurements (No.)	Wt. (g)	Av. water loss from evaporation (mg/g hr)			
			Absolute humidity			
			0.0 mg/lit.	3.3 mg/lit.	10.0 mg/lit.	12.3 mg/lit.
<i>Mus musculus</i> (white mouse)	6	9.0-23.9	3.92 ± 0.90*	3.61 ± 0.70	2.30 ± 0.69	1.36 ± 0.64
<i>Dipodomys merriami</i> (kangaroo rat)	6	30.1-37.4	1.46 ± 0.27	1.14 ± 0.21	0.94 ± 0.22	0.51 ± 0.14
<i>Perognathus baileyi</i> and <i>P. intermedius</i> (pocket mice)	8†	12.2-29.2	2.47 ± 1.02	2.18 ± 0.89	1.34 ± 0.43	0.95 ± 0.43
<i>Uma notata</i> (sand lizard)	3	15.5-16.0	0.361	0.327	0.120	
<i>Dipsosaurus dorsalis</i> (desert iguana)	1	32.0	0.197	0.159	0.0363	0.0329
<i>Phrynosoma solare</i> (horned lizard)	1	35.1	0.218			
<i>Crotalus atrox</i> (western diamond-back)	1	123	0.175			
<i>Crotalus scutellatus</i> (Mojave rattlesnake)	1	278	0.177	0.126		
<i>Scaphiopus couchi</i> (spadefoot toad)	1	24.4		6.07	3.40	

* One standard deviation.

† Two measurements were made on *P. baileyi*, six on *P. intermedius*.

with animals in a double chamber (of 1300-ml volume), with the head protruding on one side of a rubber diaphragm and the body on the other side.

The data for measurements on ten species of small vertebrates are summarized in Table 1. The inverse relationship between water loss and absolute humidity is relatively linear, indicating that a diffusion process is involved, as was previously concluded for dogs and human beings (4). In white mice and kangaroo rats, water loss at each measured humidity is significantly different from that at other humidities. As expected, the water loss in white mice is significantly higher than that in the desert rodents, *Dipodomys* and *Perognathus*. This finding confirms earlier measurements (1). Species differences are not significant above a humidity of 10.0 mg/lit.

Also, as was expected from indirect evidence (see 8 for a summary), the rate of water loss in desert-inhabiting reptiles is considerably less than that in rodents, by a factor of about 10. Evaporation from a terrestrial anuran, *Scaphiopus couchi*, is only about 2 times that from white mice and 4 times that from desert rodents.

The rate of water loss is very sensitive to changes in degree of activity of the animal. When *Perognathus intermedius* were caused to run in place for 5 to 10 minutes, they maintained a maximum rate of water loss 200 to 290 percent of their rate when sleeping. The maximal rate of loss in *Uma notata* was 413 percent of their rate when resting.

In kangaroo rats, water loss from the head averaged 87.7 percent of the total water loss, and that from the body, only 12.3 percent. These averages are only for rats whose total loss was within the range expected for sleeping, nonpartitioned individuals. The head-to-body ratio did not vary significantly with ambient humidity. Assuming that the skin of the head loses water at the same rate as that of the body, we find the ratio of water loss from respiratory organs to water loss from skin to be about 84:16. This finding supports the conclusion of the Schmidt-Nielsen (1) that the kangaroo rat has a rather insignificant loss of water through its skin. *Dipodomys merriami* is importantly different in this regard from another common desert-inhabiting rodent, *Peromyscus maniculatus*, in which loss of water from skin is about 46 percent of the total water loss (9).

The ratio of water loss from the head to water loss from the body in rattlesnakes was 70.1:29.9 for both species at humidity of 0.0 mg/lit. and 68.2:31.8 for *Crotalus scutellatus* at humidity of 3.3 mg/lit. Since the head

surface is quite small in relation to the body surface in snakes, these ratios are essentially ratios of water loss from respiratory organs to water loss from skin. As has been often contended (8), the skin of at least certain reptiles is indeed nearly waterproof.

ROBERT M. CHEW

Department of Biology, University of Southern California, Los Angeles

ARTHUR E. DAMMANN

Poisonous Animals Research Laboratory, Arizona State University, Tempe

References and Notes

1. B. Schmidt-Nielsen and K. Schmidt-Nielsen, *Am. J. Physiol.* **162**, 31 (1950).
2. R. M. Chew, *Ecol. Monographs* **21**, 215 (1951).
3. J. R. Templeton, *Physiol. Zool.* **33**, 136 (1960).
4. A. Lutcke, F. Klusmann, W. Kaufmann, *Arch. ges. Physiol., Pflüger's* **266**, 50 (1957); G. Zollner, R. Thauer, W. Kaufmann, *ibid.* **260**, 261 (1955).
5. E. D. Palmes, *Rev. Sci. Instr.* **19**, 711 (1948); R. E. Albert and E. D. Palmes, *J. Appl. Physiol.* **4**, 208 (1951).
6. J. P. Decker and B. F. Wetzel, *Forest Sci.* **3**, 350 (1957); J. P. Decker and J. D. Wien, *Plant Physiol.* **35**, 340 (1960).
7. This developmental study was supported by U.S. Public Health Service grant No. RG-7079.
8. R. M. Chew, *Biol. Revs. Cambridge Phil. Soc.*, in press.
9. —, *Ecology* **36**, 463 (1955).

3 October 1960

Electrocardiographic and Behavioral Effects of Emetine

Abstract. The effects of subacute emetine poisoning on conditioning, spontaneous behavior, and the electrocardiogram of the guinea pig are reported and compared. The depression in spontaneous behavior shown by the animals does not seem to be dependent upon any psychogenic action of emetine; there appears to be a correlation between the cardiac damage and the depression caused by the drug.

Previous research by my co-workers and me has demonstrated that emetine is a drug with specific cardiotoxicity (1). Subacute emetine poisoning provides a useful method for producing a

pathological condition of the heart of the guinea pig and may be used in evaluating the cardiac effects of drugs and other factors (1). The electrocardiographic changes observed in over 200 guinea pigs so poisoned, together with histologic studies, have suggested that emetine is able to evoke generalized myocardial damage, which spreads to the specific conduction tissue in the terminal stage of treatment (1).

Along with electrocardiographic changes, a marked behavioral depression is seen in all guinea pigs, from the first days of subacute poisoning until the death of the animals from cardiac failure, which occurs, in general, 6 to 7 days after the beginning of treatment. The onset and course of this depression seem to be closely connected with the signs of cardiac disturbance evoked by emetine. However, there are no data which permit the exclusion of interference of nervous or psychological factors in the pathogenesis of the emetine depression. Moreover, cases of polyneuritis and other nervous manifestations after emetine intoxication in man have been reported in the clinical literature (2), and many authors have reported that they obtained good results with emetine in the treatment of some neurological syndromes, such as herpes zoster (3) and alcoholic neuritis (4).

These clinical data suggest that emetine, under certain conditions, may produce neurotropic as well as cardiologic effects. However, prior to our study there had been no experimental or clinical data on psychological effects or mental disturbance attributable to emetine in therapeutic or toxic doses (1, 2). To discriminate between myocardial and psychological factors in the pathogenesis of the emetine depression, in the research reported here (5) the effects of subacute emetine poisoning on the behavior and the electrocardiogram of the guinea pig were studied and compared.

Six female guinea pigs were condi-

Table 1. Effects of subacute emetine poisoning in six guinea pigs.

Days from beginning of treatment	Animals (No.)*	Reduction of body wt. (mean %)	Electrocardiographic changes (intensity)	Depression (intensity)†	Motor disability (intensity)‡	Reduction of conditioned avoidance (intensity)‡
2	6	-3.6	+	+		
3	6	-9.3	++	++		
4	6	-12.6	+++	+++	++	++
5	6	-19.5	+++	+++	+++	+++
6	2	-23.0	+++	+++	+	+
7	2	-27.5	+++	+++	++	++
8	2	-30.5	+++	+++	+++	+++

* Four animals died on the fifth day of treatment, after body weight and spontaneous and conditioned behavior had been checked and electrocardiograms had been made. The two remaining animals died on the eighth day, after the tests had been made. † On the second day only four animals manifested depression of spontaneous behavior. ‡ No animals manifested motor disability or reduction of conditioned avoidance on the second and third days, only two on the fourth day, and only four on the fifth day.

tioned to an avoidance situation, by the method described by Mowrer (6). The unconditioned stimulus was a mild electric shock. The conditioned stimulus was a combination of a steady light and a noise. The animals were conditioned to avoid the shock by crossing a barrier from a lighted into a dark compartment of the cage. They reached the maximum percentage of positive responses—that is, conditioned avoidance—in from seven to 11 training sessions, each session comprising 20 presentations of the conditioned stimulus. After this maximum had been maintained for more than three sequential sessions, the emetine treatment, as described previously (1) was begun, and it was continued until the animals died. The animals were given 5 mg of emetine per kilogram of body weight, per day, subcutaneously. During the treatment the animals were regularly subjected to the conditioning sessions (7).

Conditioning alone did not cause reduction in body weight or any adverse symptoms (8). Electrocardiographic records made 15 minutes after the training sessions showed only a slight tachycardia. The six animals died 102, 107, 111, 116, 170, and 180 hours, respectively, after the beginning of emetine treatment (8). During this period the guinea pigs showed a progressive reduction of body weight, together with electrocardiographic changes such as depression or inversion of the T wave and tachycardia in the first days, prolongation of the PR interval and widening of the QRS complex, and, in the terminal stage, bradycardia and intra- or atrio-ventricular blocks.

By the third day of treatment, all the animals showed depression of spon-

taneous behavior, but no significant changes in conditioned avoidance were observed. Only in the terminal stage of treatment, when the animals were almost completely incapable of moving or crossing the barrier to avoid the shock, was there a marked reduction in conditioned avoidance. The mean values for conditioned avoidance in the six animals during the conditioning sessions immediately prior to emetine treatment, during the emetine depression, and during the terminal stages were, respectively, 90, 92, and 24 percent. Similarly, the other parameters of conditioning, such as the duration of each session, the number of shocks, and the number of spontaneous crossings during each session, were not significantly influenced by the emetine treatment except in the terminal stage, when the duration of each session and the number of shocks were increased as a consequence of the animals' impaired movements.

From these results, which are summarized in Table 1, it seems that a reduction in conditioned avoidance occurs only when the animals are physically incapable of moving and is not associated with the early depression produced by emetine. Since emetine is a drug specifically toxic to the heart (1), and since it does not influence the conditioning even when spontaneous behavior is depressed, it seems more likely that the depression is correlated with the heart disturbance caused by emetine than with a possible psychogenic action of this drug.

A. MARINO*

Department of Anatomy,
Laboratory of Neuropharmacology,
University of California
Medical Center, Los Angeles

References and Notes

1. An extensive bibliography on emetine cardiotoxicity is to be found in previous papers by my co-workers and me. The most recent of these are: A. Marino and E. Miele, *Boll. soc. ital. biol. sper.* **35**, 749 (1959); A. Marino and E. Russo, *ibid.* **35**, 1244 (1959); A. Marino and S. Magliulo, in preparation; A. Marino, *Pharmacologist* **2**, 73 (1960).
2. The bibliography on cases of polyneuritis and nervous involvement during emetine intoxication in man can be found in various textbooks of toxicology, such as those of C. H. Thienes and T. J. Haley [*Clinical Toxicology* (Lea and Febiger, Philadelphia, ed. 3, 1955), p. 148], W. F. von Oettingen [*Poisoning: A Guide to Clinical Diagnosis and Treatment* (Saunders, Philadelphia, ed. 2, 1958), p. 348], S. Lockett [*Clinical Toxicology* (Kimpton, London, 1957), p. 429], and S. Moeschlin [*Klinik und Therapie der Vergiftungen* (Thieme, Stuttgart, ed. 3, 1959), p. 484], and in the reports of F. J. Leibly [*Am. J. Med. Sci.* **179**, 834 (1930)] and F. Vizioli [*Führer-Wieland's Samml. Vergiftungsfällen* **9**, 5117 (1938)].
3. On the treatment of herpes zoster by emetine, see: J. Vidal, *Hospital (Rio de Janeiro)* **40**, 305 (1952); E. Griveaud and J. Achar, *Bull. franç. dermatol. syphilol.* **60**, 106 (1953); *Lyon méd.* **87**, 319 (1953); *Semaine hôp.* **35**, 872 (1959); D. V. Thuong, *Presse méd.* **62**, 955 (1954); C. Martin, *J. méd. Bordeaux et Sud-Ouest* **132**, 61 (1955); A. D. Oliveira, *J. méd. Pôrto* **26**, 709 (1955); V. Jorda, I. Lenfeld, L. Rotshchild, *Z. ges. inn. Med. u. ihre Grenzgebiete* **13**, 71 (1958); M. Favre and H. Goldmann, *Schweiz. Apotheker-Ztg.* **33**, 743 (1958); K. G. Mezcy and W. A. Piringer, *Wien. med. Wochschr.* **109**, 677 (1959).
4. For the treatment of alcoholism by emetine, see R. Lecoq, *Thérapie* **8**, 70 (1953); *Compt. rend.* **236**, 335 (1953).
5. I wish to thank Dr. A. J. Hance for his help in this study.
6. For details of the conditioning method, see O. H. Mowrer, *J. Exptl. Psychol.* **27**, 497 (1940); ——— and R. R. Lamoreaux, *Psychol. Monogr.* **54**, No. 5 (1942).
7. Control animals maintained the maximum conditioned avoidance for at least ten sequential sessions—that is, more than the period of subacute emetine poisoning.
8. In earlier research [*Pharmacologist* **2**, 73 (1960)], I found that conditioning did not significantly potentiate emetine cardiotoxicity.

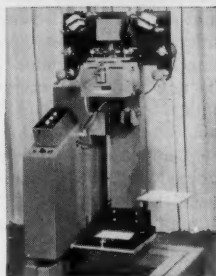
* Present address: Institute of Pharmacology and Toxicology, University of Naples, Naples, Italy.

12 September 1960

Kodak reports on:

a definition of "very good"... a mask for glass, switched by light... an interesting sandwich

High-fi photography for highbrows



This enlarger was custom-built. The client's affairs are of such a nature that to supply him with anything short of the best-performing merchandise that money can buy could have disastrous consequences for all men of good will. The enlarger is a link in an astonishing chain on which much depends.

It is indeed a very good enlarger. We are tempted to resort to the cant of the times and call it a

breakthrough in enlargers. We shall resist the temptation because we hate to lie. Nothing as climactic as a "breakthrough" has occurred in enlargers.

The reason it's a very good enlarger (the best in the world, we hope) is that some years ago it became apparent that descriptions like "very good" don't help much in dealing with such problems and that more precise-sounding terms like resolving power don't tell a full and honest story either. Progress came when we adopted the *weltanschauung* of the sound engineer, of all people!

Can you imagine the audacity of treating a photographic lens or a photographic emulsion or a combination of the two as though it were a loud-speaker or a telephone line and developing equations for its sine-wave frequency response? Yet this is what we were forced to do and it worked. The enlarger above can prove that it worked. The photographic-emulsion men and the lens men are given a common language, which they had lacked. The frequency response of a combination as in the above enlarger can be cascaded with the frequency response of other elements in the total picture-handling system, including the electronic, if any.

We have good reason to want to convince you that this nonsense is not as foolish as it sounds. We think that in the long run we shall be better off if we let you in on the principles by which we design a photographic system even though, under certain circumstances, we wish you would let us (George's successors) do it for you.

Education had best begin by studying a review paper, "Methods of Appraising Photographic Systems," by one of our men who has been up to his ears in this subject for a couple of decades. Get your free copy from Eastman Kodak Company, Apparatus and Optical Division, Rochester 4, N. Y. Freshman calculus and doggedness required.

An invitation to engrave

Etching is, of course, not the only way to dig into a glass surface. With sufficient patience and skill a grinding wheel yields superb results. If time flits too rapidly for that sort of monkeying around, you coat a resist over your surface, scribe through it, and let the HF go to work.

In case the pattern is intricate, or needs to be repeated, or both, you want a photosensitive resist. Then you can draw up the pattern once, nice and big and black, reduce it photographically onto a *Kodalith* material and use the resulting photograph as a mask which determines where the resist comes off and exposes the naked glass to HF.

Think a moment what you are asking of any photosensitive resist. It must be capable of being switched by a reasonable amount of light from one to the other of two conditions: a) tenacious adherence to the particular material you

wish to etch and impenetrability to agents which rapidly attack that material; b) abject submission to attack by agents which do not affect the substrate, or alternatively, full permeability to appropriate etchants for the substrate.

Obviously, we have given this matter much more than a moment's thought. Our researches have now brought forth a photosensitive resist for glass and silicate ceramics to join our previously announced *Kodak Photo Resist* ("KPR," for copper, clear anodized aluminum, and high-copper alloys) and *Kodak Metal-Etch Resist* ("KMER," for other metals). We would be justified in trying to recover all that thinking expense by selecting a similar proprietary name to imply the discovery of a new chemical compound but have decided on a cleverer course...

We shall have you buy *Kodak Metal-Etch Resist* and tell you how to convert it to a glass-etch resist by the use of those two arcane compounds, technical-grade aluminum stearate and sulfur-free xylene.


For details, write Eastman Kodak Company, Graphic Reproduction Division, Rochester 4, N. Y. If you don't want to bother stating your problem, just say "photosensitive resists."

Aromatic titanium



Our first entry in the class of compounds called ferrocene is a little item that goes by the name *Dicyclopentadienyltitanium Dichloride*. That is to say, the first member of the class obtainable as an Eastman Organic Chemical (Eastman 8057, 5 grams for \$4.45). Statements must be carefully worded when mentioning a compound reputed to be a stereospecific catalyst for polyolefins. Wealth of empires hangs on such things. Nobody make a move, nobody drop or pick up a hint without first consulting his or her patent department.

Academics can afford to be carefree. They can follow knowledge where e'er it leads. They can revel in ferrocenes and rejoice to see a broadening of the whole concept of aromaticity in organic chemistry. Benzene, naphthalene, such old-fashioned aromatic nuclei are essentially two-dimensional. Here aromaticity enters the third dimension. Whee!!!!

Considerations like zero dipole moment, non-polar nature, a single C-H absorption band, and the x-ray diffraction pattern cinched the pentagonal anti-prismatic "sandwich" structure for ferrocenes. Look at it up there. You would almost think that the science of chemistry has come to resemble the art of constructing ship models inside abandoned whiskey bottles. The image is historically false, however. Ferrocenes are the offspring of a casual liaison between two problems: preparation of organo-iron compounds and the hunt for a route to fulvalene, .

It soon developed you could have a filling in the sandwich other than iron. Our titanium ferrocene has a bright, gleaming copper-bronze sheen to it. The original iron ferrocene is also orange-colored. Maybe the color has more to do with the bread than with the filling. Maybe we see too many images.

There is a lot of literature around on ferrocene chemistry. We ourselves put out a review article on it a couple of years ago. We had no ferrocenes to sell then, but we did have a ferrocene expert on the payroll and wanted to show him off. Request a copy from Distillation Products Industries, Rochester 3, N. Y. (Division of Eastman Kodak Company). Same address to order five grams of the compound. Need a copy of "Eastman Organic Chemicals, List No. 42"?

Price subject to change without notice.

This is another advertisement where Eastman Kodak Company probes at random for mutual interests and occasionally a little revenue from those whose work has something to do with science

Kodak

GRASSLANDS

Editor: Howard B. Sprague 1959

6" x 9", 424 pp., 37 illus., index, cloth. Price \$9.00, AAAS members' cash orders \$8.00. AAAS Symposium Volume No. 53.

This volume is intended as a review of knowledge on many aspects of grasslands resources. The 44 authors were selected by their own professional colleagues as being particularly competent to present the respective subjects. Thirty-seven papers are arranged under these chapter headings:

1. Sciences in Support of Grassland Research
2. Forage Production in Temperate Humid Regions
3. Engineering Aspects of Grassland Agriculture
4. Forage Utilization and Related Animal Nutrition Problems
5. Evaluation of the Nutritive Significance of Forages
6. Grassland Climatology
7. Ecology of Grasslands
8. Range Management

British Agents: Bailey Bros. & Swinfen, Ltd.,
Hyde House, W. Central Street,
London, W.C.1

AAAS, 1515 Mass. Ave., NW,
Washington 5, D.C.

Letters

Interpeduncular Nucleus

Thompson [*Science* 132, 1551 (1960)] relates damage to the interpeduncular nucleus of the rat to the loss of a visually conditioned avoidance response. Since no mention is made of the closely adjacent nucleus of the posterior accessory optic tract, it would seem necessary to confirm the absence of damage to this visual center before ascribing a role in visual responses to the interpeduncular nucleus.

DAVID BODIAN

Johns Hopkins University School of
Medicine, Baltimore, Maryland

David Bodian's point, that neural structures (for example, the nucleus of the posterior accessory optic tract) other than the interpeduncular nucleus may be involved in retention of pre-operatively learned visual tasks is well taken. The following data derived from two experiments [*J. Comp. Physiol. Psychol.* 53, 488 (1960); *Exptl. Neurol.*, in press], however, strongly support my original contention [*Science* 132, 1551 (1960)] that the interpeduncular nucleus has a significant role in visual responses: (i) the degree of retention loss is directly related to the amount of damage to the interpeduncular nucleus; (ii) lesions placed immediately lateral, superior, or posterior to the interpeduncular nucleus are without effect; (iii) lesions in the region of the posterior accessory optic tract are without effect; and (iv) damage to the habenulopeduncular tract produces a deficit similar to that found with damage to the interpeduncular nucleus.

ROBERT THOMPSON

Neuropsychiatric Institute, University of
California Medical Center, Los Angeles

I would like to comment on the report of the President's Science Advisory Committee as it appeared in *Science* [132, 1802 (1960)]. As I read through the report, I was struck by one glaring lack: hardly anywhere, except inadequately in the section called "Background," was there any questioning of why we scientists should do research. In that section, a pat on the back is given to the idea that research, that knowledge, is good for its own sake, but the main emphasis is on the "material returns of scientific investigation," on a "recognition that the defense and advancement of freedom require excellence in science and in technology."

Now I do not want to quarrel with this division. We all recognize that not only science but all the arts—everything which lifts man above the brutes

—should have the support of the government and of the people. But, once we recognize that scientific endeavor has another function, that of increasing real wealth, of eradicating poverty and misery—once we recognize this function, should we not also go about seeing to it that scientific research is so conducted that we can obtain these hoped-for results? Oh, I know that many scientists will immediately cry out, "Planned research! Conducted research!" But is not our research in this country mostly conducted, conducted for the government, for "defense," for private profit? I hear no complaints from these people about this kind of research.

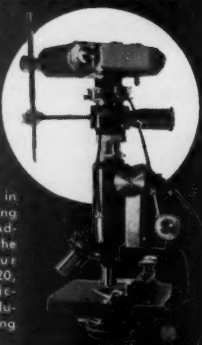
What I would like to have read in that report was a summary of the areas where we could have more scientific research and of areas where we could immediately end research without loss to anyone. With no direction, talent is wasted, and the good name of science is besmirched in the public mind. For example, should so much money have been spent on a relatively minor disease, poliomyelitis? Do we really need research so that we can travel faster on this earth, or get to the moon within our lifetime? We have many problems which cannot be solved by improved weedkillers, or improved nasal sprays, or improved antibiotics. Our urban sprawls are spawning inhumanity; our resources are being squandered, our air is being polluted. Why cannot we do away with the internal-combustion engine and get some research going on something to take its place, without noise, without pollution, without a wastage of scarce resources? Racial tensions are increasing all over the world; this is assuredly a problem which scientists can tackle. All your readers can multiply instances of such problems many fold, and I am sure all the problem-areas that they cite will be relevant, and all will be amenable to scientific endeavor.

You will say that it was not the purpose of the advisory committee to talk about these things. I answer that it was precisely in their province, if they were going to ask for more federal help and money, to give some ideas as to where this money and these brains are going to be used. Once you accept the idea that scientific research has goals besides the burgeoning forth of new knowledge to set beside the knowledge that has been handed down to us from previous generations—once you accept the idea that science should act to make more men's lives better, more humane, sacrosanct, then it devolves upon you to make it clear where this research should be conducted, in what fields, to meet what needs.

If this is not done—and if the report is accepted it will not be done—then, to the layman, more scientific research

RECORD YOUR OBSERVATIONS with a UNITRON PHOTOMICROGRAPHY SET!

An inexpensive accessory that duplicates the performance of costly apparatus. For every type of microscopy and photography. Easy to operate. Allows continuous observation while camera is in place, even during time exposures. Adjustable to fit the camera of your choice (35mm., #120, #127, motion picture, etc.). A valuable aid for teaching or learning.



FREE 10-DAY

TRIAL

Model ACA

\$39⁹⁵

Postpaid

UNITRON

INSTRUMENT COMPANY • MICROSCOPE SALES DIV.
66 NEEDHAM ST., NEWTON HIGHLANDS 61, MASS.

Please rush to me, UNITRON's Microscope Catalog 4-L-2

Name _____

Company _____

Street _____

City _____ State _____

will mean more gadgets, more and better bombs, more drastic, unnecessary changes in the conduct of our life. Really now, do we honestly need communications satellites? I have talked to many nonscientists, and to them, more scientific research means deadlier wars. Right or wrong, this is a conception, and it is up to us scientists to do something about this, or else we will be damned, and, I think, rightly so.

PHILIP SIEKEVITZ

Rockefeller Institute,
New York, New York

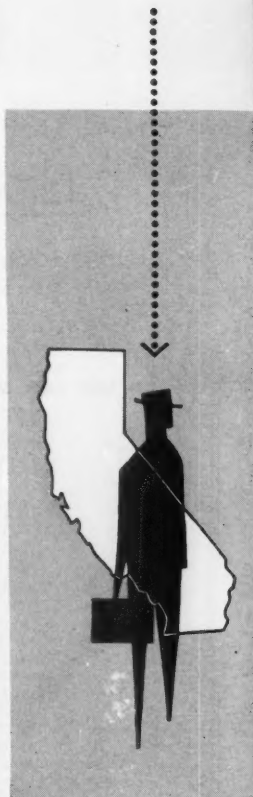
Western Snake River Fault Zone

Malde [*Science* 130, 272 (1959)] has described a zone of northwest-trending, high-angle faults which have displaced the western Snake River Plain downward relative to highlands on the north by at least 9000 feet; 5000 feet of the movement occurred between the early and middle Pliocene, and the balance occurred in Cenozoic time. His studies are based in part on numerous gravity measurements, and from an "analysis of a 50-milligal residual anomaly associated with the steep gravity gradient near Mountain Home, it is calculated that from 13,000 to 38,000 ft of rocks about as dense as Columbia River basalt have been dropped down against the Idaho batholith."

Kirkham [*J. Geol.* 39, 210 (1931)], from a plane table traverse of Squaw Butte near Emmett, calculated a thickness of 17,000 feet for the Columbia River basalt exposed in the butte. He said that this thickness would not hold if faults were found. While the faults are not particularly obvious on the surface, they are easily observed from an airplane. The rocks are tilted at various angles, from 8 to 40 degrees, and form narrow north-south wedges. Horizon markers are not easily identified in the Columbia River basalt, but it is obvious from the large amount of displacement visible from the air that the actual thickness of the basalt is of the order of 3000 rather than 17,000 feet. I have studied these basalts over large areas of Oregon, Washington, and Idaho and believe that a thickness in southern Idaho of appreciably more than 4000 feet is not likely. It might be argued that Snake River basin was a down-faulted basin in which the basalts pooled and became unusually thick. However, nothing in the appearance of the basalts next to the major fault zone indicates that the basalts are ponded. It seems more likely that steep gravity gradient near Mountain Home is due to thin wedges of Columbia River basalt downdropped along the border of the plain against the Idaho batholith, leading to an error in calculated thick-

Who is this man?

First, you should know a few things about him: He's responsible, as a man who leads others through new frontiers must be; he's a specialist ... but a specialist with time for creative reverie; he welcomes new challenges and grows in learning and stature with whatever he faces; he's mature, dedicated, and inquisitive—traits of a true man of science. Who is he? He's the indispensable human element in the operations of one of the Navy's laboratories in California. Could he be you?



U. S. NAVAL ORDNANCE TEST STATION at China Lake and Pasadena: Research, development, testing, and evaluation of missiles, advanced propulsion systems, and torpedoes and other undersea weapons.

U. S. NAVAL ORDNANCE LABORATORY at Corona: Development of guidance and telemetry systems and missile components. Research in IR spectroscopy, magnetism and semiconductors, etc.

U. S. NAVAL RADIOLOGICAL DEFENSE LABORATORY at San Francisco: One of the nation's major research centers on nuclear effects and counter-measures.

U. S. NAVY ELECTRONICS LABORATORY at San Diego: One of the Navy's largest organizations engaged in the research and development of radar, sonar, radio, and acoustics.

PACIFIC MISSILE RANGE and U. S. NAVAL MISSILE CENTER at Point Mugu: National launching and instrumentation complex, guided missile test and evaluation; astronautics; satellite and space vehicle research and development.

U. S. NAVAL CIVIL ENGINEERING LABORATORY at Port Hueneme: Research, development, and evaluation of processes, materials, equipment, and structures necessary to the design, construction, and maintenance of the Navy's shore bases.

Openings for Aeronautical Engineers, Chemists, Civil Engineers, Electronic Engineers, Electronic Engineers (Digital Circuitry & Electro-Acoustic), Mathematicians (Test Data Processing & Analysis), Mechanical Engineers, Operations Research Analysts, Physicists.

The man we want must have an advanced degree, or a Bachelor's degree with at least three years' solid experience. He should contact . . .

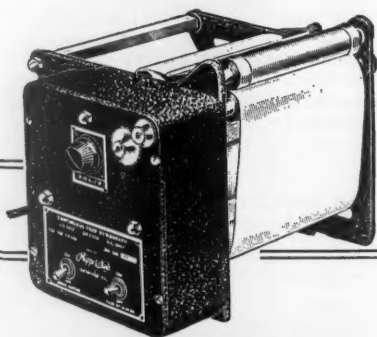
Personnel Coordinator, Dept. B
U. S. Naval Laboratories in California
1030 East Green Street
Pasadena, California

**U. S. NAVAL LABORATORIES
IN CALIFORNIA**

ETHODIN

for preparation of
GAMMA GLOBULIN

Available from
**Special Chemicals Dept.
WINTHROP LABORATORIES**
1450 Broadway, New York 18, N.Y.



Bird, Continuous Feed KYMOGRAPH

The outstanding features of modern industrial recorders are retained in this instrument without losing the versatility necessary for kymograph work. Ink writing levers are used exclusively.

The machine feeds an 80 foot roll of paper, 6 inches wide, at any of its eight speeds. Four of these are had with external gears of 40 and 56 teeth in one position; by simply operating a gear-shift knob. By reversing the external gears, four additional speeds become available.

Cat. No. 70-140

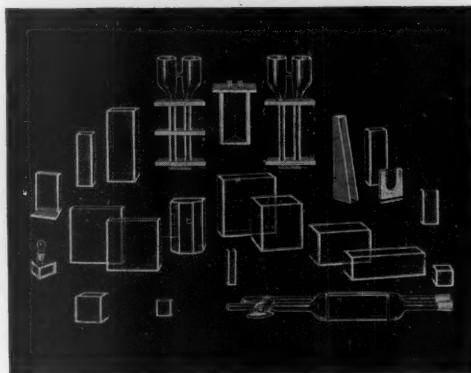
PHIPPS & BIRD, INC.

Manufacturers & Distributors of Scientific Equipment



6th & Byrd Streets - Richmond, Va.

GLASS ABSORPTION CELLS made by **KLETT**



SCIENTIFIC APPARATUS
Klett-Summerson Photoelectric Colorimeters—
Colorimeters—Nephelometers—Fluorimeters—
Bio-Colorimeters—Comparators—Glass Stand-
ards—Klett Reagents.

Klett Manufacturing Co.
179 East 87 Street, New York, New York

OUTSTANDING ASSIGNMENTS for OUTSTANDING SCIENTISTS at the OPERATIONS EVALUATION GROUP of M. I. T.

Seeking scientists who have the ability and imagination to apply their broad knowledge with *originality* in the field of research, the Operations Evaluation Group of the Massachusetts Institute of Technology offers stimulating career opportunities to scientists with advanced degrees in mathematics and the physical sciences.

For over 18 years, OEG has served as advisor to the Office of Chief of Naval Operations and the operating fleet. Engaged in both conventional operations research and in the solution of complex problems far out of the realm of the ordinary, OEG has the responsibility for conducting research that cuts laterally across many scientific disciplines.

If you have the interest and the creative ability to apply your basic research findings to the solution of problems that are vital to the Navy and the national security, you are invited to write to OEG. Working in a professional atmosphere and exchanging stimulating ideas with colleagues of the same discipline, you will find a rewarding opportunity for increased scientific stature and personal growth.

OPERATIONS EVALUATION GROUP An Activity of the Massachusetts Institute of Technology

Department F
Washington 25, D. C.

Physicists • Physical Chemists • Mathematicians
Economists • Electronics Engineers

ness similar to that which caused Kirkham to miscalculate the thickness in Squaw Butte.

HAROLD T. STEARNS
Post Office Box 241, Wahiawa, Hawaii

Competitive Exclusion Principle

It may seem unwarranted to extend the series of comments on the competitive exclusion principle, which has now proceeded from Hardin [*Science* 131, 1292 (1960)] to Cole [132, 348 (1960)] to Savile [132, 1761 (1960)], with asides by Van Valen versus Cole [132, 1674 (1960)]. However, two points in the discussion by Savile deserve comment.

He asserts that "the absence of clearly defined associations" emphasizes the reduced importance of competition in the arctic flora. Considerable recent vegetational research, some of which I summarized in an article in *Science* [128, 115 (1958)], suggests that clearly defined associations may not be characteristic and that the vegetation in an area may be regarded as changing in a manner most effectively treated as a continuous variable. It is, therefore, questionable whether the absence of clearly defined associations emphasizes anything. Savile's suggestion that the flora, or better the vegetation, be described in terms of major habitats, if these are discernible independently of the vegetation itself, certainly has merit.

Secondly, Savile refers to "closely related species with identical ecological requirements." If we must beware of assuming that species have different ecological environments because they do coexist, we must also beware of speaking of two species' having identical ecological requirements. The ecological demands of well-known species are not usually known in detail, and there is always the possibility that some essential requirement of a species may escape our most careful observation or experimentation. It may be argued that the plant as it integrates the multiple and undetermined components of the environment is the most, and perhaps the only, adequate measure of its environmental requirements. In any event, the assertion of ecological identity is fraught with at least as many difficulties as the assumption of lack of identity.

ROBERT P. MCINTOSH
Department of Biology, University of
Notre Dame, Notre Dame, Indiana

McIntosh's first point concerns the permanence of associations. With our currently ameliorating climate I feel certain that all plant associations are changing throughout temperate Canada, but that does not rob the association concept of its usefulness, if we use it

with discretion. The lack of such associations in most arctic habitats, whether we use this term or indulge in circumlocution, still reflects meager biological competition—as others with arctic field experience have agreed since my note appeared.

In his final paragraph McIntosh questions my phrase "identical ecological requirements" used in connection with disease resistance. I used the words, following ecological practice, with some misgiving, realizing that a semantic wrangle might ensue. Consider the extreme case of a single plant species with two populations differing by a single

gene that governs disease resistance. The parasite being part of the environment, these populations have different ecological requirements. Thus, if we insist on complete precision, no two species will ever have identical requirements, and the exclusion principle becomes completely meaningless, whereas, if we realize that usable definitions of biological phenomena must generally be flexible, the principle can be moderately useful under many, but not all, circumstances.

D. B. O. SAVILE
Canada Department of Agriculture,
Ottawa

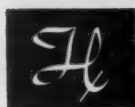
ISOLATE CHROMATOGRAPH FRACTIONS QUICKLY, ACCURATELY

HAMILTON FRACTION COLLECTOR



You can isolate exceedingly pure gas chromatograph fractions for supplemental analysis with this *single* instrument—the Hamilton Fraction Collector! It uses the "Freeze-Out" method of fraction collection, capturing the sample in a U tube on ultra pure silica sand chilled to liquid nitrogen temperatures... *providing up to 98% plus recovery!*

- Rapid, easy, one stroke operation
- Available with heated line for high boiling fractions
- 10 second preparation; samples at 5 second intervals
- Unlimited fractions from single run
- Economical fraction containers, no stopcocks, need no grease



Order direct, or write today for literature and prices.
Also available through your supply house.

HAMILTON COMPANY, INC.
P. O. Box 307-K Whittier, California

PRECISION MEASURING EQUIPMENT FOR CLINICAL AND MEDICAL RESEARCH

Meetings

Forthcoming Events

March

1-3. Chemistry Symp., intern. (by invitation), Stanford, Calif. (B. Lamar, Stanford University News Service, Stanford, Calif.)

2-4. Optical Soc. of America, spring meeting, Pittsburgh, Pa. (Miss M. Warga, 1155 16th St., NW, Washington 6, D.C.)

2-5. National Wildlife Federation, 25th annual, Washington, D.C. (Natl. Wildlife Federation, 1412 16th St., NW, Washington 6)

5-9. Gas Turbine Conf. and Products Show, 6th annual, Washington, D.C. (Meetings Dept., American Soc. of Me-

chanical Engineers, 29 W. 39 St., New York 18)

6-8. North American Wildlife and Natural Resources Conf., 26th, Washington, D.C. (C. R. Gutermuth, Wildlife Management Inst., 709 Wire Bldg., Washington 5)

7-9. American Railway Engineering Assoc., annual, Chicago, Ill. (N. D. Howard, 59 E. Van Buren St., Chicago 5)

8-10. Instrument Soc. of America Conf., 11th annual, Pittsburgh, Pa. (R. R. Webster, 900 Agnew Ave., Pittsburgh 30)

8-11. Neurosurgical Soc. of America, Boca Raton, Fla. (R. K. Thompson, 803 Cathedral St., Baltimore 1, Md.)

9-10. Magnetohydrodynamics, symp. on engineering aspects of, Philadelphia, Pa. (N. W. Mather, Project Matterhorn, P.O. Box 451, Princeton, N.J.)

12-17. American College of Allergists,

annual, Dallas, Tex. (P. Gottlieb, 818 Medical Arts Bldg., Philadelphia, Pa.)

13-17. National Assoc. of Corrosion Engineers, annual, Buffalo, N.Y. (W. A. Mapler, 18263 W. McNichols Rd., Detroit 19, Mich.)

13-24. Radiological Health, course in, Cincinnati, Ohio. (Chief, Training Program, Sanitary Engineering Center, 4676 Columbia Parkway, Cincinnati 26)

14-16. Clinico-Pathological Significance of Renal Biopsy, Ciba Foundation symp. (by invitation only), London, England. (Ciba Foundation, 41 Portland Place, London, W.1)

14-16. Inter-Station Supersonic Track Conf., 6th symp., China Lake, Calif. (U.S. Naval Ordnance Test Station, Code 307, China Lake, Calif.)

15-17. Medical Photography and Cinematography, intern. cong., Cologne, Germany. (Deutsche Ges. für Photographie, Neumarkt 49, Cologne)

16-17. Textile Engineering Conf., American Soc. of Mechanical Engineers, Clemson, S.C. (ASME Meetings Dept., 29 W. 39 St, New York 18)

16-18. Aviation/Space Education, 5th natl. conf., Washington, D.C. (Natl. Aviation Education Council, 1025 Connecticut Ave., NW, Washington 6)

17-19. International Medical Conf., Liège, Belgium. (Medical Commission of the FIR, Castellezgasse 35, Vienna II)

19-25. American Soc. of Photogrammetry, American Cong. on Surveying and Mapping, Washington, D.C. (C. E. Palmer, ASP, 1515 Massachusetts Ave., NW, Washington 5)

20-22. American Physical Soc., Monterey, Calif. (W. A. Nierenberg, Univ. of California, Berkeley 4)

20-23. Institute of Radio Engineers, 1961 intern. convention, New York, N.Y. (E. K. Gannett, IRE, 1 E. 79 St., New York 21)

20-24. American Surgical Assoc., Boca Raton, Fla. (W. A. Altemeier, Cincinnati General Hospital, Cincinnati 29, Ohio)

20-24. National Health Council, forum and annual meeting, New York, N.Y. (NHC, 1790 Broadway, New York 19)

20-24. Western Metal Cong. and Exposition, 12th, Los Angeles, Calif. (A. R. Putnam, American Soc. for Metals, Metals Park, Ohio)

21-23. American Meteorological Soc., general meeting, Chicago, Ill. (E. P. McClain, Dept. of Meteorology, Univ. of Chicago, Chicago 37)

21-23. American Physical Soc., Division of High-Polymer Physics, 21st, Monterey, Calif. (D. W. McCall, Bell Telephone Laboratories, Murray Hill, N.J.)

21-23. American Power Conf., 23rd annual, Chicago, Ill. (W. C. Astley, Philadelphia Electric Co., 900 Sansom St., Philadelphia 5, Pa.)

21-24. American Assoc. of Anatomists, 74th annual, Chicago, Ill. (O. P. Jones, Dept. of Anatomy, Univ. of Buffalo, Buffalo 14, N.Y.)

21-30. American Chemical Soc., 139th. St. Louis, Mo. (A. T. Winstead, ACS, 1155 16th St., NW, Washington 6)

23-25. American Orthopsychiatric Assoc., 38th annual, New York, N.Y. (M. F. Langer, AOA, 1790 Broadway, New York 19)

(See Issue of 20 January for comprehensive list)

SCIENCE, VOL. 133



every laboratory
has the space
and a job
for the...

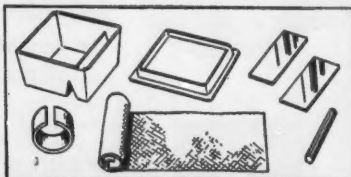
CHROMATOBOX®

for paper
chromatography

It measures only 3" x 3" x 2", and produces a 17" paper chromatogram faster, easier, more economically than larger equipment. Uses only 10 to 15 ml of solvent; quickly saturates its small atmosphere. Little jobs done in the CHROMATOBOX leave cabinets and jars free and uncontaminated for larger jobs. Use it for solvents that damage other apparatus. All parts are solvent resistant plastic or glass.

The low price and convenience of the CHROMATOBOX open new opportunities to every user—

Students can be given individual practice in developing chromatograms. ■ Lectures can be illustrated with active demonstrations. ■ Test strips can be run that were previously neglected because of the bother with larger equipment. ■ The scope of clinical laboratories can be broadened with data given only by chromatography.



Price \$10 F.O.B. Richmond, California. Dept. A.



RESEARCH SPECIALTIES CO.

200 SOUTH GARRARD BLVD. RICHMOND, CALIFORNIA

11th Edition

INDUSTRIAL RESEARCH LABORATORIES

of the U. S. and Canada

This guide to the activities, personnel, and services of 5,420 laboratories is invaluable to management, scientists, engineers, government officials, librarians, and all others interested in research and development in American industry. Laboratory entries include key research officers, statements of ownership, and indications of the numbers of scientists engaged in various fields.

In addition to the subject and geographic indexes found in earlier editions, the 11th Edition provides a personal-name index of approximately 20,000 individuals involved in research. This index constitutes a virtual Who's Who in American Industrial Research. Publication #844, 700 pp., \$12.00, postpaid.

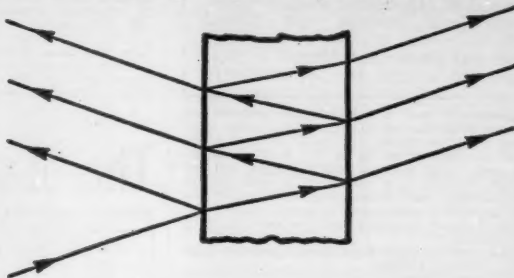
Printing and Publishing Office

National Academy of Sciences
National Research Council

2101 Constitution Avenue, N.W.
Washington 25, D. C.

INTERFERENCE FILTERS

for isolating narrow spectral bands



Spectral Range: 340-900 millimicrons

Peak Transmission: 40%

Half Peak Width: 8-12m μ

Size: 2" x 2"

For

Colorimetry
Fluorimetry
Flame Photometry

also microscopy, photomicrography, microcolorimetry, refractometry, polarimetry, light scattering measurements, and for many other applications requiring monochromatic light in the visible, near-ultraviolet, and near-infrared range.

Write for Bulletin #180 to

PHOTOVOLT CORP.

95 Madison Avenue

New York 16, N.Y.

PERSONNEL PLACEMENT

CLASSIFIED: Positions Wanted. 25¢ per word, minimum charge \$4. Use of Box Number counts as 10 additional words. Payment in advance is required.

COPY for ads must reach **SCIENCE** 2 weeks before date of issue (Friday of every week).

DISPLAY: Positions Open. Rates listed below—no charge for Box Number. Rates net. No agency commission. No cash discount. Minimum ad: 1 inch. Ads over 1 inch will be billed to the nearest quarter inch. Frequency rate will apply to only repeat of same ad. No copy changes. Payment in advance is required except where satisfactory credit has been established.

Single insertion \$40.00 per inch
4 times in 1 year 38.00 per inch

For **PROOFS** on display ads, copy must reach **SCIENCE** 4 weeks before date of issue (Friday of every week).

Replies to blind ads should be addressed as follows:
Box (give number)
Science
1515 Massachusetts Ave., NW
Washington 5, D.C.

POSITIONS WANTED

Blood Plasma Protein Fractionation. B.S., 42, 17 years' production and administrative know-how: serum albumin, immune globulin, and fibrinogen. Isolation of plasma proteins, freeze drying, sterile filtration, and filling. Seeks production and/or development position in same or related field. Box 20, **SCIENCE**. 2/17; 24

Plant Microbiologist. Ph.D., 9 years' research experience in phytopathology, microbial genetics, phage investigations, radiobiology. Desires research or research-teaching position. Box 21, **SCIENCE**. X

Young Veterinary Pathologist. Ph.D., seeks research commercial or teaching position. Box 25, **SCIENCE**. X

POSITIONS WANTED

Nutritionist-Biochemist. Ph.D., 37, academic industrial experience; background in metabolic studies, connective tissue diseases. Seeks association with research institute, academic position. Box 26, **SCIENCE**. 2/17

Pathologist. M.D. American Board Certified; four years' hospital practice as laboratory director; director medical technology school. Considerable administrative, organizational, and teaching experience. Also trained in internal medicine. Desires position in cancer research, especially leukemias, lymphomas. Institute, university, or organization in basic research. Would consider situation establishing research laboratory, all aspects, or situation combining practice with research. Box 22, **SCIENCE**. X

Professor of Health Physics or equivalent. Substantial research and teaching experience. Presently technical director laboratory. Ph.D., age 42. Box 23, **SCIENCE**. X

Recent Microbiology Ph.D. with 10 years' teaching-research experience desires teaching-research position. Available September. Box 24, **SCIENCE**. 2/24

Scientist-Translator will translate Japanese technical documents. \$30 per 1000 words. Hiroshi Oyama, 307 Decatur, Monterey, Calif. 1/27; 2/3, 10

POSITIONS OPEN

PHYSICAL SCIENTISTS

Look for openings at
MELPAR

See our advertisement
on page 351

POSITIONS OPEN

ORGANIC CHEMIST

(Antibiotic Research)

M.S. in organic chemistry plus experience in natural product isolation, purification and characterization.

Send detailed resume & salary requirements to **PERSONNEL DEPT.**

SCHERING CORP.

60 Orange St. Bloomfield, N.J.

Ph.D.—Antibiotic Research. Position available in Research Division for very able person to head group doing fermentation work on laboratory scale and genetic studies. Antibiotic experience essential. Send résumé to:

Personnel Director
Bristol Laboratories
Box 657, Syracuse 1, New York

Tissue Culture Course

The annual course in Principles and Techniques of Tissue Culture sponsored by the Tissue Culture Association will be given at the University of Wisconsin, Madison, Wisconsin, 19 June to 14 July 1961. A limited number of participants (post-doctoral research workers and teachers) can be admitted. The course will be directed by Dr. JOHN PAUL of Glasgow University and Dr. WILLIAM G. COOPER of the University of Colorado School of Medicine. For further information and application forms, address Dr. Mary S. Parshley, College of Physicians and Surgeons, 630 West 168th Street, New York 32, New York. Tuition \$100. Deadline for application, 15 April 1961.

POSITIONS OPEN

Medical Writer-Editor

Unusual opportunity for scientifically trained or experienced medical writer. Professional position with Ethical Pharmaceutical Division of expanding chemical corporation located in New York City suburbs. Box 19, SCIENCE.

Applications are invited for the position of Assistant Professor of Physics. Salary range is at present \$6500 to \$8500. The main research interest of the department is in the field of dielectrics, and there are excellent facilities for this research. Ottawa is a center of government research activity, and cooperation with other laboratories in the Ottawa area is encouraged. Many regular specialist seminars and symposia are held in the district. Please apply to Dr. John Hart, Carleton University, Ottawa, Canada.

OUR 65th YEAR

(a) **Microbiologist**: outstanding scientist to supervise medical microbiology group of 20 doing research in host factors, transformation reactions, applied research on coccidiostats, anti-bacterial, antifungal actions for prominent eastern company; also (b) **Biochemist**: interested, experienced nutrition, metabolism research to serve as supervisor, nutrition group, same organization; able to do basic fundamental research; requires outstanding scientific, supervisory ability to head promising young group; salaries for both minimum \$15,000 plus substantial benefits. (c) **Biochemist**: Ph.D., or M.S. to head busy department, very large southwestern hospital; to \$12,500 for Ph.D.; university city 200,000. (d) **Bacteriologist**: M.S., equivalent to direct department, 270-bed general hospital; vicinity \$7500; New York City residential location. (e) **Bacteriologist**: B.S., M.S. to head department, hospital now expanding to 350 beds; southeastern coastal city 50,000. (f) **Neurochemist**: research in degeneration, regeneration central nervous system; possible faculty appointment outstanding midwestern university medical school. (g) **Bacteriologist**: Ph.D. to head busy section, 700-bed general hospital; university city, South-Central. (h) **Biochemist**: M.S., Ph.D. experienced clinical chemistry in general hospital to head department; will have outstanding facilities on completion present program; 600-bed southern hospital. (i) **Clinical Chemist**: M.S., Ph.D. to operate laboratory, large, active general hospital; opportunity individual investigations; able organize, supervise technical staff; New York City. **Woodward Medical Bureau**, Ann Woodward, Director, 185 North Wabash, Chicago. **FOUNDERS OF THE COUNSELLING SERVICE TO THE MEDICAL PROFESSION—SERVING MEDICINE WITH DISTINCTION OVER HALF A CENTURY.** X

UNIQUE CHALLENGE. Openings for physicist, chemist, astronomer, and geologist with graduate degrees, Ph.D. preferred. To instruct at Summer Science Camp. Educational experiment where science is taught in the relaxed surroundings of the outdoors. Small selected enrollment of boys with high aptitude and interest in science. Modern facilities and equipment. Salary open. Director, Adirondack Science Camp, State University College of Education, Plattsburgh, N.Y. 2/10

University of Otago, Dunedin, New Zealand

DEAN OF THE FACULTY of HOME SCIENCE

The University proposes to appoint a Dean of the Faculty of Home Science in succession to Professor Elizabeth Gregory, Ph.D., who is to retire shortly. The Dean to be appointed will also be a Professor in one of the fields covered by the work of the School. The salary is £N.Z. 2,800 p.a.

Further information may be obtained from the Secretary, Association of Universities of the British Commonwealth, 36 Gordon Square, London W.C.1., or from the undersigned. Applications close in New Zealand and London on April 30, 1961.

J. W. Hayward,
Registrar

FELLOWSHIPS

Applications are being accepted for graduate study in Microbiology leading to Ph.D. Research and training programs in progress on biochemical and biological aspects of normal and virus-infected tissue culture systems and other aspects of virology, mechanisms controlling bacterial cell division, electron transport, bacteriophage genetics and biochemistry, immunology, and nucleic acid and protein synthesis. Adequate fellowship stipends available. Write to Chairman, Department of Microbiology, Saint Louis University School of Medicine, St. Louis 4, Missouri. X

The Market Place

BOOKS • SERVICES • SUPPLIES • EQUIPMENT

DISPLAY: Insertions must be at least 1 inch in depth. Weekly invoices will be sent on a charge account basis—provided that satisfactory credit is established.

Single insertion	\$40.00 per inch
4 times in 1 year	38.00 per inch
7 times in 1 year	36.00 per inch
13 times in 1 year	34.00 per inch
26 times in 1 year	34.00 per inch
52 times in 1 year	32.00 per inch

For PROOFS on display ads, copy must reach SCIENCE 4 weeks before date of issue (Friday of every week).

SUPPLIES AND EQUIPMENT

Mice
CAESAREAN-DERIVED
CHARLES RIVER CD-1
Hypophysectomies
THE CHARLES RIVER MOUSE FARMS
Affiliate, The Charles River Breeding Labs
1018 Beacon St., Brookline 46, Mass. RE 4-2000

1919 - 1961
LaMotte Chemical
Chestertown, Maryland, U.S.A.
Specialists in

Colorimetric Techniques
Reagents-Standards-Comparators
Send for Illustrated
Controls Handbook Dept. H

DL 5-HYDROXYTRYPTOPHAN and other significant Indole Derivatives

REGIS Chemical Company
1219 N Wells Street Chicago 10, Illinois



THE JUNIOR
Garceau
Electroencephalograph
THE JUNIOR
Price \$575.00 complete
No Batteries
Requires no Shielding
Prompt Delivery
A.C. Operated
Inkless Writing
Shipped Ready to Run

**ELECTRO-MEDICAL
LABORATORY, INC.**
South Woodstock 2, Vermont

SWISS MICE

BACTERIOLOGICAL AND GROSS
TISSUE STUDY TECHNIQUES USED
IN OUR QUALITY CONTROL

HUNTINGDON FARMS, INC.
2548 NORTH 27th ST. PHILA. 32, PA.

SUPPLIES AND EQUIPMENT

"From the hand of the veterinarian
to research!"



albino rats

CHARLES RIVER CD
(Caesarean derived)
CHARLES RIVER SD
(Sprague-Dawley descendants)
CHARLES RIVER W
(Wistar descendants)

HYPOPHYSECTOMIZED RATS

- Only Charles River CD animals used
- Rigidly controlled environment (same bldg.) birth to surgery.
- High speed surgery by graduate biologists.
- 10 years experience animal surgery.
- Overnight air service from Boston

THE CHARLES RIVER BREEDING LABS

1018 Beacon St., Brookline 46, Mass. RE 4-2000
Henry L. Foster, D.V.M., President

YOU NEED THIS FREE CATALOG FOR YOUR FILES

Serums, antiserums and bloods
of all kinds for technicians and tissue
culture laboratories. No salesman will call.

COLORADO SERUM CO.
4950 York St. • MAIN 3-5373 • Denver 16, Colo.

BOOKS AND MAGAZINES

SCIENTIFIC JOURNALS WANTED

Sets, Runs and Volumes bought at top prices.
Your wants supplied from
our Back Files of over 3,000,000 periodicals.
Abrahams Magazine Service N. Y. 3, N. Y.

Your sets and files of scientific journals

are needed by our library and institutional customers. Please send us lists and description of periodical files you are willing to sell at high market prices. Write Dept. A3S, CANNER'S, Inc., Boston 20, Massachusetts

Proceedings of a conference by
NAS-NRC Committee on Photobiology

PHOTOPERIODISM AND RELATED PHENOMENA IN PLANTS AND ANIMALS

922 pp., 256 illus., 1959 \$14.75
\$12.50 cash orders from AAAS members

AAAS

1515 Massachusetts Ave., NW
Washington 5, D.C.



Needed: Engineers to chart the dimensions of 1965 weapons systems

"Too often companies are satisfied with the accomplishments of today and allow schedule pressures to prevent concentration on tomorrow's business.

"This is not true at Martin-Orlando. We have established a group of high level engineers—the Technical and Research Staff—who have the responsibility for creating and developing the skills and systems that will form the basis for Martin's business in the time span 1965-1970.

"Finding the men who can staff the 23 technologies necessary is not an easy task. It calls for engineers who are interested in technical rather than administrative accomplishment. It calls for engineers who have the clarity of concept to discard convention. It calls for engineers unhampered by 'tunnel vision'—who can translate the tactical requirements of the future into engineering reality. It calls for engineers who can do the jobs and meet the qualifications shown on the right.

"Martin-Orlando—prime contractor for Pershing, Bullpup, GAM-83, Lacrosse, Missile Master and BIRDIE—is working on the threshold of the future. If you feel you would like to join us, are qualified, and would enjoy living in Florida, we would very much like to hear from you."

James B. Louser

Director, Technical and Research Staff

Martin-Orlando's Technical and Research Staff has immediate openings for high level engineers and scientists in all 23 technologies being studied. Among these are:

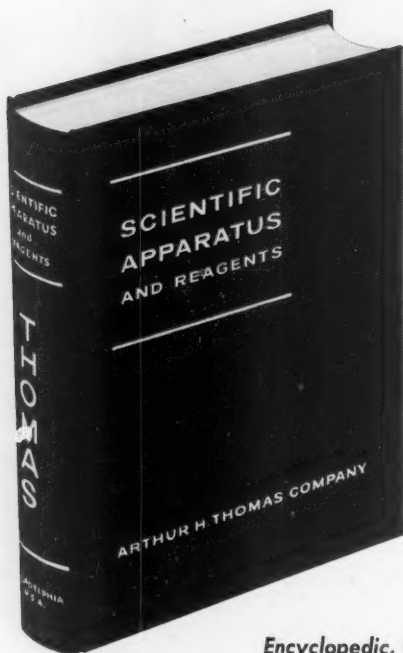
- **OPERATIONS RESEARCH**—Operations Research is of prime importance in the Technical and Research Staff and is conducted primarily on the systems level in such efforts as weapons systems analysis, operational gaming and simulation, and system modeling.
 - **ELECTRONIC SYSTEMS**—conceptual design and evaluation of advanced systems. Of significant interest at this time are high resolution techniques, missile detection and guidance, analytical studies of new communication systems.
 - **COMPUTER TECHNIQUES**—digital systems and logic design for unique weapon systems applications. Concept through prototype experience desired.
 - **INFORMATION THEORY**—as applied to communications, guidance or radar systems with emphasis on information theory, information processing, statistical theory of communications, decision theory, optimum coding and detection.
 - **INERTIAL GUIDANCE**—conceptual and analytical investigation of advanced inertial guidance systems. Experience should be in modern weapons systems with emphasis on systems analysis for employment of inertial guidance techniques, and/or conception and design of all or major portions of inertial guidance components.
 - **GROUND SUPPORT EQUIPMENT CONCEPT AND DEVELOPMENT**—emphasis on mobile missile systems analysis. Backgrounds in missile and equipment handling, servicing equipment development, transport and transport vehicle evaluation, soil mechanics, hard based installations, and power generation systems are applicable. Experience with military logistics and tactical military operations highly desirable.
- Other technologies in which immediate openings exist include: Electronic Packaging, Environments Prediction, Structures (Conceptual Analysis and Design), Human Factors, Missile Propulsion.

If you are interested in and qualify for senior level work with this highly select staff, please contact C. H. Lang, Employment Manager, The Martin Company, Orlando 30, Florida.

WORK IN THE CLIMATE OF ACHIEVEMENT

MARTIN
ORLANDO

New . . . for laboratories of Chemistry and Biology



Thomas Catalog ANNIVERSARY EDITION

Encyclopedic, factual, convenient

More comprehensive than former editions, with changes in format which have resulted in a lighter weight volume, more convenient to handle.

More than 20,000 items

New edition lists more than 20,000 items of Apparatus and Reagents, adequate stocks of which are regularly carried in our stock for immediate shipment. The Index is replete with cross references.

Selection of Apparatus

Selection is based on careful review and evaluation by our Technological staff. We therefore accept full responsibility for the satisfactory performance of every item listed.

Distribution of the Catalog

Copies will be sent to laboratory and purchasing personnel. Suggestions as to the catalog requirements of your laboratory or department will aid us in making adequate distribution.



ARTHUR H. THOMAS COMPANY

More and more laboratories rely on Thomas

Laboratory Apparatus and Reagents

VINE ST. AT 3RD • PHILADELPHIA 5, PA.

